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Fur Seal Investigations, 1969

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NATIONAL MARINE FISHERIES SERVICE
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Fur Seal Investigations, 1969

By

MARINE MAMMAL BIOLOGICAL LABORATORY

Special Scientific Report—Fisheries No. 628

Seattle, Washington
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Fur Seal Investigations, 1969

By

National Marine Fisheries Service[1]
MARINE MAMMAL BIOLOGICAL LABORATORY
Naval Support Activity
Seattle, Washington 98115

ABSTRACT

Field investigations of the fur seal, *Callorhinus ursinus*, in 1969 were conducted on the Pribilof Islands from June to October and in the eastern North Pacific Ocean, off the State of Washington, in February and March.

The kill included 38,678 males and 230 females.

We counted 10,276 living adult males in June and 10,597 in July.

Dead fur seals counted included 14,810 pups and 286 animals older than pups.

The main causes of death among 208 pups were malnutrition, hookworm disease, and microbial infections.

The average weights of pups in late August were 9.8 kg. for males and 8.6 kg. for females.

We marked 25,775 pups of both sexes and 3,419 male seals presumed to be ages 1 and 2, and recovered 3,558 marked male seals.

Tag loss varies with tag series. Data on the relative effectiveness of two kinds of marks used on fur seals are inconclusive.

Estimates of the number of pups born in 1966 were 461,000 from tagging and 390,000 from shearing and sampling. According to sheared to unsheared ratios, an estimated 303,500 pups were born in 1969.

The forecasted kill of males in ages 2 to 5 in 1970 is 53,700. The predicted kill of males in ages 2 to 5 in 1969 was 56,500; the actual kill was 38,440.

About 68 percent of 334 young males tagged on St. Paul Island in 1968 and 69 percent of 555 tagged there in 1969 have since been recovered on the Pribilof Islands. Four of eleven transmitters attached to young males were unaccounted for at the end of the season in 1969.

Weights of the bacula of young males ranged from 3 to 11 dg. at age 2 to 13 to 45 dg. at age 5, and weights of the testes ranged from 9 to 18 g. at age 2 to 23 to 99 g. at age 5.

The number of females collected at sea in 1968 were too few to permit a comparison of body lengths and reproductive conditions between animals on St. Paul Island and at sea during comparable periods.

Organochlorine pesticides were found in the tissues of fur seals, sea lions, and marine birds.

[1] Formerly the U.S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries.

Of 1,136 fur seals sighted off Washington, 334 were collected, 41 were wounded and lost, and 42 were killed and lost.

Solitary seals were more prevalent than paired or large groups of animals.

Fifty-four percent of 299 females killed were from 1 to 7 years old, and 48 yearling seals from the 1968 year class were taken.

Twenty-six marked seals were collected.

Pregnancy rates have ranged from 38 to 90 percent for females age 5 and older collected off Washington in February and March since 1958.

Fifty-five percent of 140 fetuses collected in 1969 were males.

Forty-eight percent of the nonpregnant seals 4 to 19 years of age had ovulated.

Anchovy was the leading species in 190 stomachs that contained food. Rockfish, capelin, and salmonids followed in importance. Salmon were the most valuable of the commercial fishes eaten by fur seals off Washington in 1969.

INTRODUCTION

In 1969 the Pribilof Islands fur seal population began its climb to a new level. Females will not again be killed intentionally until about 450,000 pups are born annually. We are not able to predict how many years will be required for this level of pup production to be reached. With average survival perhaps 5 years will be needed to accumulate a total of more than 700,000 females 3 years old or older needed to produce 450,000 young. Exceptional survival such as that experienced by the year classes of 1952 and 1958 or poor survival like that of the year class of 1956 will substantially change the time required to bring the number of females to the desired level.

We believe the population is sufficiently reduced now so that density-dependent mortality causes do not strongly influence it. The reason for the extreme success or failure of some year classes has not been determined. We suggest that the variations are caused by changes in the environment that we are not yet able to relate to survival of fur seals. Forecasting the strength of year classes depends on understanding this relationship. Until we know and can measure the factors that determine survival to age 3 years, forecasts have limited usefulness for the year intended. Their use in planning sales of furs or for other economic uses 2 or more years in the future is unwarranted.

The distribution and numbers of fur seals off Washington and southern British Columbia, as well as their size, reproductive performance, and food were studied. The studies, which are coordinated with Canadian research, will be carried on for several years. The results, insofar as possible, will be correlated with the population changes taking place on the Pribilof Islands.

Part I, on land investigations, was prepared by the staff making studies on the Pribilof Islands: Alton Y. Roppel, Project Leader (Wildlife Research Biologist); Ancel M. Johnson, Biometrician (Wildlife Research Biologist); Raymond E. Anas, Fishery Research Biologist; Mark C. Keyes, Research Veterinarian; and Douglas G. Chapman (Director of the Center for Quantitative Analysis, University of Washington, Contract No. 14-17-0001-2146), consultant.

Part II, on pelagic investigations, was compiled by staff biologists: Clifford H. Fiscus, Project Leader (Wildlife Research Biologist); and Hiroshi Kajimura, Fishery Research Biologist. Merrill A. Petterson and Stephen D. Treacy, Biological Technicians, took part in the 1969 operations. Temporary employees Robert G. Forbes and Arthur A. Harvey assisted with the ocean work.

Ford Wilke, Laboratory Director

Part I. FUR SEAL INVESTIGATIONS, PRIBILOF ISLANDS, ALASKA, 1969

This report summarizes fur seal research carried out on the Pribilof Islands in 1969 from June to October as part of a program designed to provide a basis for determining the level at which the herd will produce a maximum sustained yield.

The glossary describes terms having special meanings in fur seal research, figures 1 and 2 show the locations of rookeries and hauling grounds on the Pribilof Islands, and appendix B lists persons engaged in fur seal research on the Pribilof Islands in 1969. In this report, "Pribilof Islands" include St. Paul and St. George Islands and, occasionally, Sea Lion Rock. There are no fur seal rookeries on Otter and Walrus Islands.

Alton Y. Roppel, Project Leader

AGE CLASSIFICATION AND NUMBER OF SEALS KILLED, BY SEX

Male seals only were purposely killed on the Pribilof Islands in 1969; 230 females were taken accidentally and were not classified by age.

All available males without manes were taken. Small seals <42 inches (107 cm.) in

Figure 1.—Location of rookeries and hauling grounds, St. Paul Island.

Figure 2.—Location of rookeries and hauling grounds, St. George Island.

body length from tip of nose to tip of tail, allowed to escape in previous years, were killed in 1969. The animals were killed each week from 25 June to 1 August Monday through Saturday beginning at 6 a.m. on St. Paul Island and Mondays, Wednesdays, and Fridays beginning at 9 a.m. on St. George Island.

We sampled 20 percent of the males killed 22-26 July for age and body length to continue a study of the relation between body length and abundance.

No effort was made to kill seals on inaccessible hauling ground areas such as Zapadni Point and parts of Ardiguen and Gorbatch Rookeries, or to frighten them away from these areas.

A kill of 38,678 males in ages 2 to 6 included 32,621 taken on St. Paul Island and 6,057 from St. George Island (tables A-1 to A-4). Trends in the availability of 3- and 4-year-old males taken in these kills to 31 July are given in figure 3 for St. Paul Island and in figure 4 for St. George Island. The age composition of the kill on each island was determined daily by rookery from right upper canine teeth collected from 20 percent of the males killed.

Table 1 and figure 5 give the kill of males on the Pribilof Islands from year classes 1947 to 1967.

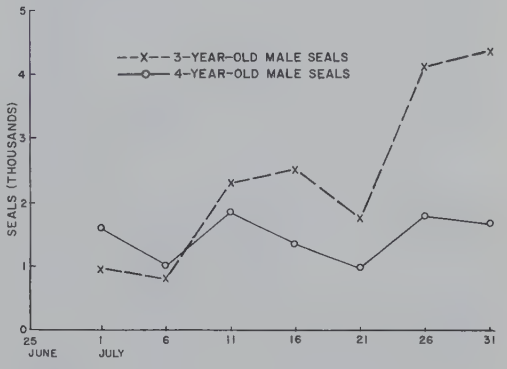


Figure 3.—Three- and four-year-old male seals killed, St. Paul Island, 25 June to 31 July 1969.

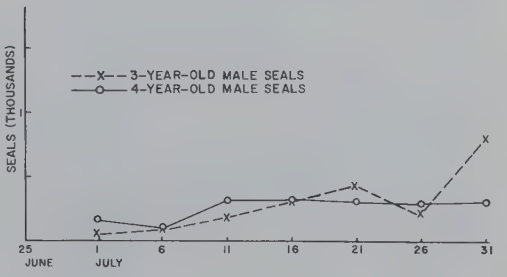


Figure 4.—Three- and four-year-old male seals killed, St. George Island, 25 June to 31 July 1969.

SURVEY DATA

We collected several kinds of data in 1969 to increase our knowledge of the herd's reaction to management programs. Living adult males and dead seals were counted, causes of and trends in pup mortality were established or extended, and living pups were weighed.

Living Adult Male Seals Counted

The living adult males (approximately age 7 and older) on all rookeries were counted in June and July on St. Paul and St. George Islands and on Sea Lion Rock (tables A-5 to A-8).

Attempts to increase the utilization of young males in recent years by harvesting large 4-year-olds and some of the small 5- and 6-year-olds have been successful, as shown by a decline in the number of idle males counted in mid-July of 1969 (table A-9) to 25 percent of the average number counted from 1960 to 1962. A decrease in the number of harem males to 58 percent of the average number counted during the same period is attributed partly to the decline in numbers of idle males but primarily to a reduction in the number of breeding females.

Table 1.--Kill of male seals,[1/] by year class, Pribilof Islands, Alaska, 1954-67

Year class	St. Paul Island					St. George Island					Grand total
	Age when killed					Age when killed					
	2	3	4	5	Total	2	3	4	5	Total	
	Number					Number					Number
1954	2,918	23,473	5,599	554	32,544	535	6,651	2,779	162	10,127	42,671
1955	1,015	27,863	10,555	115	39,548	555	7,246	2,825	260	10,886	50,434
1956	885	10,671	2,762	532	14,850	171	2,251	1,387	218	4,027	18,877
1957	2,590	24,283	15,344	773	42,990	242	5,098	4,492	244	10,076	53,066
1958	1,977	48,458	14,149	1,587	66,171	431	9,413	3,707	540	14,091	80,262
1959	2,820	26,456	14,184	1,764	45,224	891	5,890	4,690	492	11,963	57,187
1960	1,619	14,310	10,533	1,240	27,702	636	4,332	2,579	178	7,725	35,427
1961	1,098	22,468	12,046	1,270	36,882	921	6,948	2,592	502	10,963	47,845
1962	2,539	19,009	12,156	1,287	34,991	1,139	3,736	3,881	392	9,148	44,139
1963	1,264	25,535	11,785	1,542	40,126	167	5,586	3,738	406	9,897	50,023
1964	3,143	26,991	13,279	1,469	44,882	391	7,622	3,680	680	12,373	57,255
1965[2/]	2,200	18,706	10,565	-	31,471	740	4,443	2,204	-	7,387	38,858
1966[2/]	1,673	17,826	-	-	19,499	443	2,645	-	-	3,088	22,587
1967[2/]	2,640	-	-	-	2,640	411	-	-	-	411	3,051
Total	28,381	306,049	132,957	12,133	479,520	7,673	71,861	38,554	4,074	122,162	601,682
Mean	2,027	23,542	11,080	1,103	[3/] 37,752	548	5,528	3,213	370	[3/] 10,116	[3/] 47,868

1/ Includes only age 2- to 5-year-old seals taken during the kill of male seals on the Pribilof Islands. From 1956 to 1967, 131 1-year-olds and 685 6-year-olds were taken on St. Paul Island and 20 1-year-olds and 319 6-year-olds were taken on St. George Island. In addition, age was not determined for 4,919 males taken on St. Paul Island, nor for 1,522 taken on St. George Island.

2/ Incomplete returns.

3/ 1965, 1966, and 1967 year classes not included.

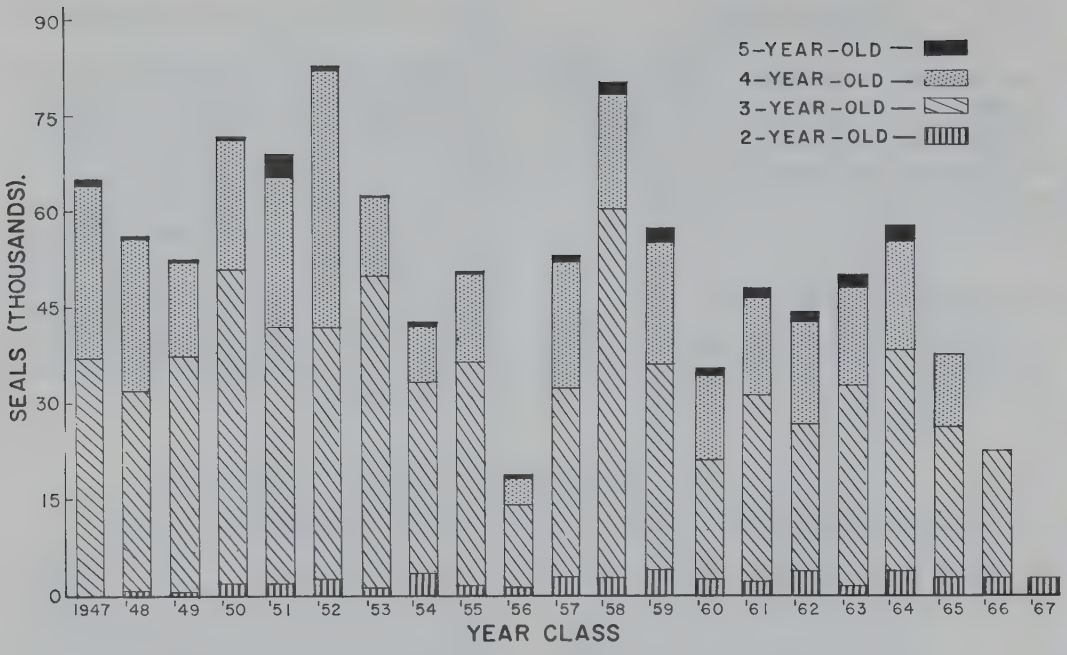


Figure 5.—Kill of male seals, by year class, Pribilof Islands, Alaska, 1947-67.

Harem and idle males counted in mid-July of 1966-69 are compared by rookery in table A-10, and the adult males counted in June of those years are compared by class and rookery in table A-11.

Living Pups Weighed

We have weighed pups annually since 1957 on St. Paul Island to continue a study of the relation, if any, of body weight in autumn to the kill of males from the year class at ages 2 through 5. The average weights of the pups in 1969 were 9.8 kg. for males and 8.6 kg. for females. These weights were 0.3 kg. more for males and 0.2 kg. more for females than the average of weights for 1957-69 (table A-16).

In 1969, as in other years, differences were significant between the weights of pups from different rookeries ($P<0.01$) and between the weights of males and females ($P<0.01$) (table 2). Differences between sexes were greater than differences between rookeries. Table 3 gives the variances and means of the weights of pups.

Table 2.—Analysis of variance in the weights of living seal pups, St. Paul Island, 28-29 August 1969

Source	Degrees of freedom	Sums of squares	Mean squares
Rookeries	3	128.28	[1]42.76
Sexes	1	265.65	[1]265.65
Interaction	3	3.10	1.03
Error	792	2033.42	2.57
Total	799	2430.45	

[1] $P<0.01$.

Dead Seals Counted That Were Older Than Pups

We found 116 males and 170 females older than pups dead on the beaches of St. Paul and St. George Islands in 1969, and collected the canine teeth from most of them for studies of age and mortality (some of the males had lost their canines). Table 4 gives the number of dead animals of each sex counted since 1965.

Table 3.—Variances in, and means of, the weights of living seal pups, St. Paul Island, 28-29 August 1969

Sex and rookery	Sample size	Variance	Mean
	Number		Kg.
Males:			
Zapadni Reef	100	2.6156	9.2
Polovina	100	3.9373	9.9
Reef	100	1.9969	10.0
Morjovi	100	3.3151	10.1
All rookeries	400		9.8
Females:			
Zapadni Reef	100	1.7393	7.9
Reef	100	2.0763	8.8
Morjovi	100	2.4629	8.9
Polovina	100	2.3965	9.0
All rookeries	400		8.6

Table 4.--Dead seals counted that were older than pups, Pribilof Islands, Alaska, 1965-69

Year	St. Paul Island		St. George Island		Total	
	Males	Females	Males	Females	Males	Females
	----Number-----		-----Number----		-----Number----	
1965	158	No count	No count	No count	158	No count
1966	181	172	41	55	222	227
1967	108	157	41	28	149	185
1968	98	141	33	22	131	163
1969	94	141	22	29	116	170

Dead Pups Counted

The number of pups that died on the Pribilof Islands in 1969 was the lowest since the counts were begun in 1941. At the current year class size of about 375,000 pups (established in 1962), our counts of dead pups have ranged from 14,810 in 1969 to 51,189 in 1962 (table A-12). The mean for the 8-year period was 30,493.

Dead pups counted on St. Paul and St. George Islands in 1969 are given in table A-13 by rookery and rookery section.

Alton Y. Roppel

PATHOLOGY

From 26 June to 15 August, M. C. Keyes and T. A. Gornall collected 208 dead pups from catwalks on study areas at Reef and Northeast Point Rookeries (Marine Mammal Biological Laboratory, 1970a). Keyes and E. W. Giddens[2] discarded 20 because of advanced post mortem degeneration and necropsied 188. Tabulations of gross pathologic findings from the 188 form the basis for this report. Giddens and A. D. Carlos[3] will eventually publish histopathologic and microbiologic findings from the tissues of 75 pups, and this information will be summarized in our report on fur seal investigations in 1970.

A tabulation of primary diagnoses[4] shows that the main (66.3 percent) causes of death among 208 pups in 1969 were malnutrition, hookworm disease, and microbial infection (table 5). Trauma, multiple hemorrhage-perinatal complex, and undetermined causes were less important. A comparison of the incidence of these six causes over a 5-year period for study area 1 and a 3-year period for area 3 (figs. 6 and 7) show significant year-to-year variations, particularly for malnutrition.

A weekly summary of primary diagnoses (table A-14) shows that deaths from malnutrition were relatively constant from 28 June to 15 August, and that 84 percent of the deaths from hookworm occurred between 18 July and 8 August. Deaths from microbial infection peaked in mid-July but otherwise occurred throughout the breeding season, whereas most of the deaths from trauma and perinatal complex occurred before mid-July.

Malnutrition

The overall drop in pup deaths from 379 in 1968 to 208 in 1969 was caused mainly by a marked decrease in deaths from apparent

[2] Certified veterinary pathologist, Department of Experimental Animal Medicine, University of Washington School of Medicine, Seattle, Wash.

[3] Veterinary microbiologist, Department of Experimental Animal Medicine, University of Washington School of Medicine, Seattle, Wash.

[4] The cause of death for each necropsy is diagnosed as primary, secondary, tertiary, and so on. A specific cause is designated primary if it is the most serious or if it preceded and influenced critical changes that eventually led to death. Secondary and tertiary diagnoses, where indicated, are not tabulated in this report but are recorded on individual necropsy forms. The distribution of secondary causes among primary causes was reported for necropsies performed in 1966 (Marine Mammal Biological Laboratory, 1969).

Table 5. --Primary diagnoses[1/] for causes of death among seal pups, three mortality study areas, St. Paul Island, 26 June to 15 August 1969

Causes of death	Study area: Reef Rookery, Area 1 Old catwalk, Dead pups		Reef Rookery, Area 2 New catwalk, Dead pups		Northeast Point, Area 3 Hutchinson Hill, Dead pups		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Malnutrition	18	27.3	17	34.0	21	22.8	56	26.9
Hookworm disease	9	13.6	8	16.0	41	44.6	58	27.9
Trauma	7	10.6	4	8.0	2	2.2	13	6.3
Bite wounds	(5)	(7.6)	(2)	(4.0)	(2)	(2.2)	(10)	
Skull fractures	(2)	(3.0)	(1)	(2.0)	(0)	(0.0)	(3)	
Liver rupture	(0)	(0.0)	(1)	(2.0)	(0)	(0.0)	(1)	
Infection (microbial)	8	12.1	10	20.0	6	6.6	24	11.5
Navel	(5)	(7.6)	(3)	(6.0)	(3)	(3.3)	(11)	
Peritonitis	(2)	(3.0)	(4)	(8.0)	(0)	(0.0)	(6)	
Pleuritis	(0)	(0.0)	(2)	(4.0)	(0)	(0.0)	(2)	
Enteritis	(0)	(0.0)	(1)	(2.0)	(2)	(2.2)	(3)	
Cellulitis	(0)	(0.0)	(0)	(0.0)	(0)	(0.0)	(0)	
Abscess	(1)	(1.5)	(0)	(0.0)	(1)	(1.1)	(2)	
Multiple hemorrhage-perinatal complex	6	9.1	3	6.0	2	2.2	11	5.3
Miscellaneous	1	1.5	2	4.0	4	4.4	7	3.4
Stillborn	(0)	(0.0)	(0)	(0.0)	(2)	(2.2)	(2)	
Accidental asphyxia	(0)	(0.0)	(1)	(2.0)	(1)	(1.1)	(2)	
Premature	(0)	(0.0)	(0)	(0.0)	(1)	(1.1)	(1)	
Hernia	(0)	(0.0)	(1)	(2.0)	(0)	(0.0)	(1)	
Hemorrhagic gastritis	(1)	(1.5)	(0)	(0.0)	(0)	(0.0)	(1)	
Undetermined	8	12.1	3	6.0	8	8.6	19	9.1
Unsuitable for examination	9	13.6	3	6.0	8	8.6	20	9.6
Total	66	100.0	50	100.0	92	100.0	208	100.0

1/ See footnote 4 of text.

malnutrition (181 in 1968 to 56 in 1969). Marked fluctuations in apparent malnutrition may be the main cause of marked fluctuations in pup mortality from year to year.

The pathogenesis of malnutrition is not known. Possibly 1 percent of pup deaths from malnutrition is frank starvation because of the usual mortality of post partum females. In 1968 (Marine Mammal Biological Laboratory, 1970b) we stated that at the present population level, separation of mother and pup owing to crowding is probably not the only—and possibly not the most important—cause of malnutrition, and that perhaps some disease process is involved. From an epizootiological standpoint, malnutrition has fluctuated like an infectious disease since 1964 when we began our studies of mortality. In the last 3 years, the total number of deaths from malnutrition on the three study areas has varied from 72 to 181 to 56, although the total number of pups born on St. Paul Island has stayed about the same. One disease process that has been related to malnutrition to some degree year after year is necrotic and necrohemorrhagic enteritis. Figure 8 shows the relation between the number of pups that have died of apparent malnutrition and the number of these pups that also have had enteritis. The incidence of enteritis seems to be positively correlated with, but not proportional to, the incidence of malnutrition.

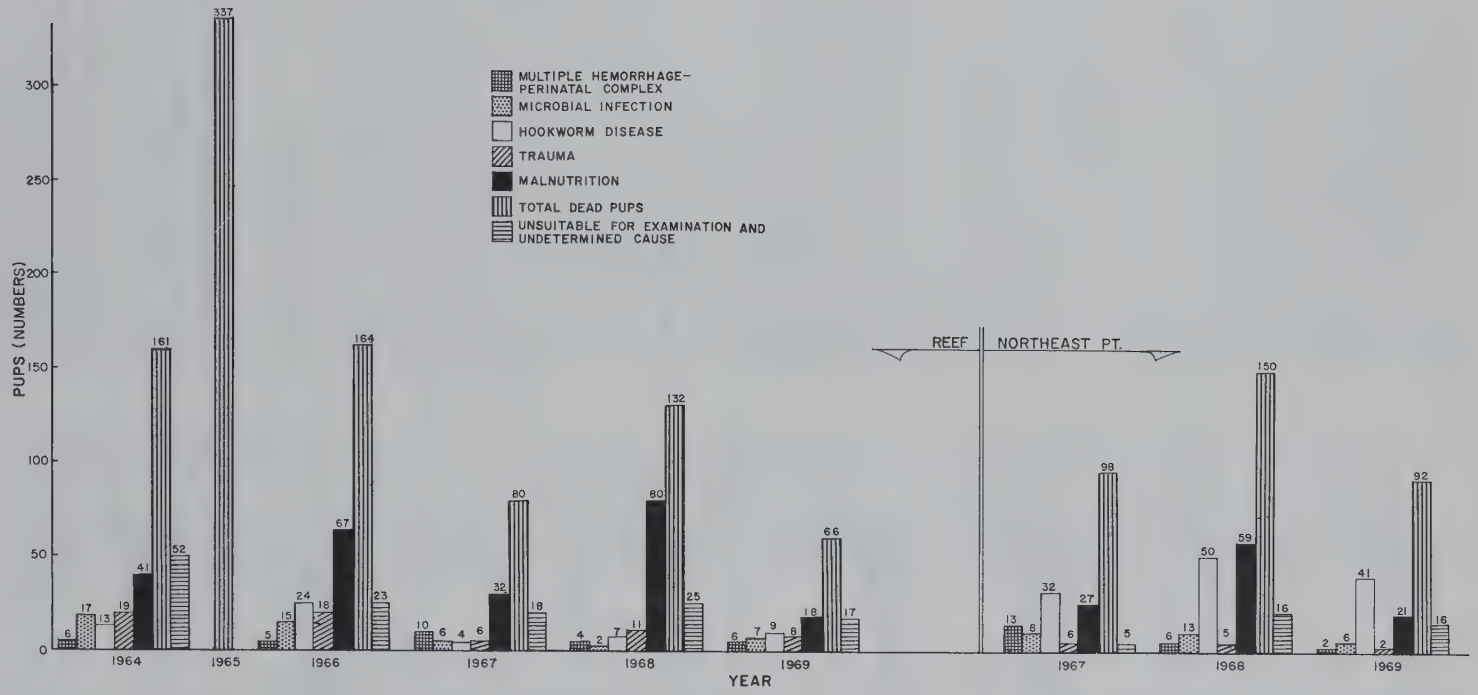


Figure 6.—Number of pups that died of various causes, Reef Rookery study area 1, 1964 and 1966-69, and Northeast Point study area 3, 1967-69, St. Paul Island.

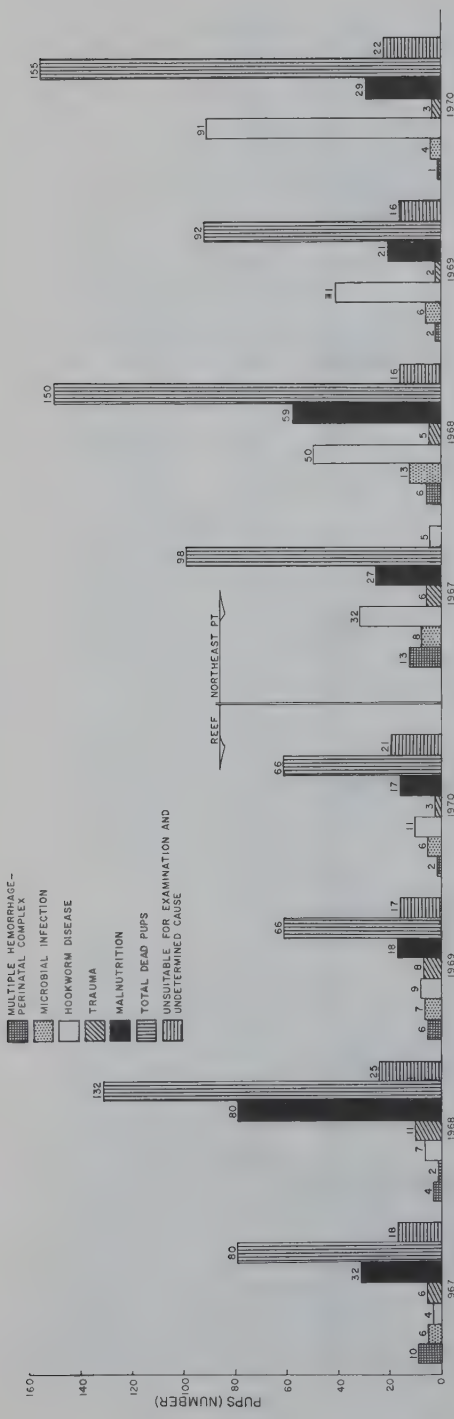


Figure 7.—Percentage of pups that died of various causes, Reef Rookery study area 1, 1964 and 1966-69, and Northeast Point study area 3, 1967-69, St. Paul Island.

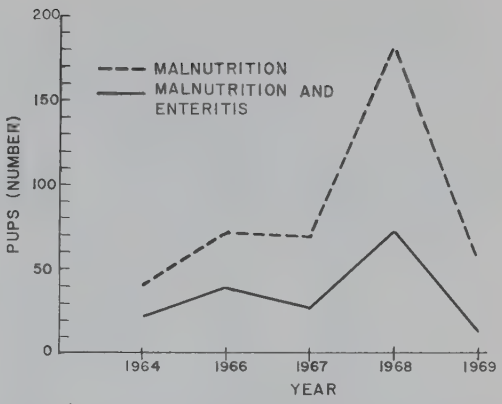


Figure 8.—Correlation of pup deaths from malnutrition with death from malnutrition and enteritis, St. Paul Island, 1964 and 1966-69.

Malnutrition was a secondary cause of death in two cases each of enteritis and cause undetermined; in one case each of hookworm disease, perinatal complex, bite wound, and hemorrhagic gastritis; and in three pups unsuitable for examination.

Hookworm Disease

The percentage of deaths from hookworm disease in 1969 for all study areas combined was 27.9, or 11 percent more than in 1968, although the number decreased from 64 to 58.

For the 3d consecutive year that area 3 on Vostochni Rookery at Northeast Point has been used as a study area, the death rate there from hookworm disease has been much higher than in areas 1 and 2 on Reef Rookery (table 5).

Microbial Infection

The most prevalent form of microbial infection was omphalophlebitis (navel infection) and peritonitis, the primary cause of death in 11 and 6 pups, respectively. Enteritis was the primary cause of death in 2 pups and a secondary cause in 13 pups that died of malnutrition. Infection was a secondary cause of death in 7 of 10 pups that were severely bitten.

Multiple Hemorrhage-Perinatal Complex

We described and discussed this disease in 1967 and 1968 (Marine Mammal Biological Laboratory, 1970a and 1970b). A summary of associated lesions and circumstances from all cases in 1964 and from 1966 to 1969 is given in table A-15. The cause is unknown, but histopathological and microbiological investigations are still in progress.

Mark C. Keyes

MARKING

Seals on the Pribilof Islands have been marked in various ways as a basis for making estimates of the population and for studying growth, mortality, behavior, and distribution of seals at sea. Pups of both sexes have been permanently marked by tagging and cutting off part of a flipper as a checkmark, by removing part of a flipper only, and by cryogenic (freeze) branding. Additional pups have been temporarily marked by shearing a patch of fur from the top of the head. Metal tags have also been attached to the front flippers of male seals in ages 1 to 6, and a few young males have had radio tags harnessed to them in addition to metal tags attached to their front flippers. Some females have been freeze branded.

Application of Marks

Monel cattle-ear tags have been used to mark seals on St. Paul Island since 1941 and on St. George Island from 1956 to 1968. A few of the tags used in recent years have been coated with blue or white epoxy. Table A-17 gives the pups marked since 1960 by tagging or by removing parts of flippers, and table A-18 shows seals age 1 or older marked by tagging since 1961.

Pups.—In 1969, we marked pups by removing the tips of digits or by cryogenic branding.

Flipper marking.—Twenty thousand pups on St. Paul Island were marked in early September by removing the tip of the first digit on the left hind flipper next to the web (fig. 9). Five thousand pups on St. George Island were marked 18-19 August by removing the tip of the first digit on the right hind flipper (fig. 9). Marking quotas of 20,000 and 5,000 pups were distributed among the rookeries of their respective islands according to the distribution of class 3 males counted in mid-July.

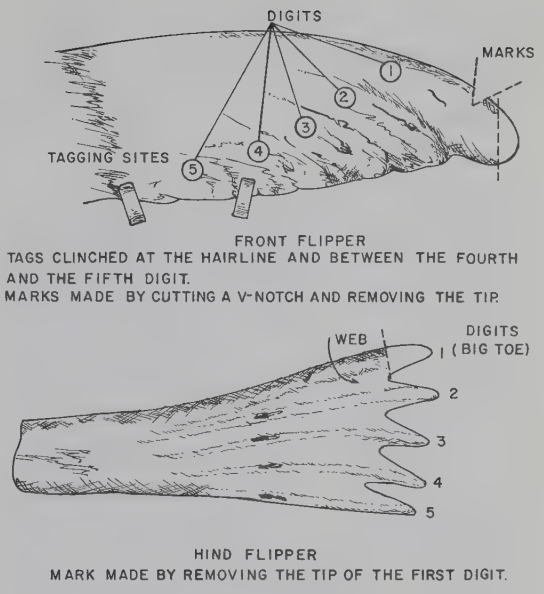


Figure 9.—Examples of mark locations that have been used on fur seals, Pribilof Islands, Alaska.

Alton Y. Roppel

Cryogenic marking.—The process of cryogenic or "freeze" branding and trial use of this marking technique on fur seals in 1966 and 1967 has been described by Keyes (Marine Mammal Biological Laboratory, 1969, 1970a). He obtained good depigmentation of guard hairs and underfur of the forearms of pups by applying for 10 seconds a superchilled copper branding instrument having a mass-to-surface-area ration of 138.5 g./228 mm.^{2} = 0.6. Raymond Anas observed and reported a "very distinct" mark on one of these seals 2 years later.

In 1969, we used the same technique to mark 775 fur seal pups on the left forearm and head. Each pup was given a different number of from

one to three digits represented by angles according to a system copyrighted by Farrell (1969) (fig. 10). Right angles or straight lines in various combinations designate a number by their orientation to the fur line of the flipper.

We assigned identical series of numbers to males and females on each of two rookery areas, and differentiated each group with dissimilar brands on the head (fig. 10). On Area 1 of Reef Rookery we marked males with numbers from 0 to 192 (— to 1< ⌜) and females from 0 to 180 (— to 1⌞—). On Area 0 (—) of Gorbatch Rookery, we marked males and females with numbers from 0 to 200 (— to ⌜ — —). Three pups were inadvertently branded with the same numbers as other pups; otherwise each of the 775 freeze-branded pups will be individually marked by the growth of white hair from the treated follicles.

The skin was prepared for branding by removing the fur with Stewart Clipmaster[5] electric clippers (by Sunbeam), then wetting the bare skin with absolute isopropyl alcohol. The clippers had blades (EA1SUR) specially designed by Farrell for close clipping and were operated from a portable generator.

Pups were made to straddle a large sand bag atop a small wooden table while the superchilled instruments were applied. Eight men freeze branded 775 pups in about 26 hours. The last 400 were marked in 10 hours, including transport of men and materials and herding the pups.

Pups were freeze branded in 1969 as part of a 4-year marking program designed to create a pool of seals that are individually identifiable without handling for various studies over entire lifespans.

Mark C. Keyes and Ancel M. Johnson

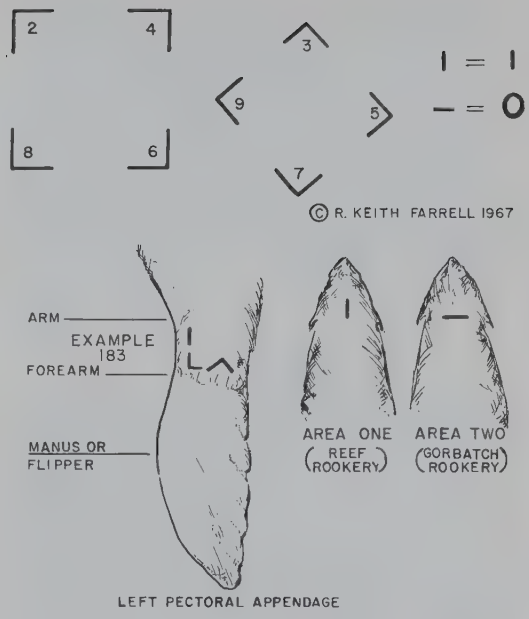


Figure 10.—System of identification symbols used as cryogenic brands applied to 775 pups, St. Paul Island, August 1969.

Male seals ages 1 and 2 years. — In 1966 and subsequent years, we increased the yearling tagging program begun in 1961 on St. Paul Island to include males estimated to be 2 years old. We continued to measure small males and give those <100 cm. in body length (tip of nose to tip of tail) tags with a "1" ahead of the letter series, temporarily designating them yearlings. Small seals longer than 100 cm. were judged to be 2 years old and were given tags with a "2" ahead of the letter. In 1969, the two programs were combined and all males known or believed to be 1 or 2 years old were given 1V-series tags (table A-19), but none were measured. All of the animals were tagged on hauling grounds. We attempted to tag 4,000 seals. The true age of each seal at the time of tagging will be determined from a canine tooth that will be collected when the animal is killed on the Pribilof Islands or elsewhere. In past years, some seals judged to be 2 years old were 1, 3, or 4 years of age.

Of 3,419 males tagged in 1969 on St. Paul Island, 81 had tags attached when the animals were pups on the Pribilof Islands and 29 had lost their pup tags; 3 had been tagged at age 1, and 2 at age 3; 3,300 had never been marked; and 4 had been tagged as pups by the U.S.S.R. on the Commander Islands. All seals without tags were given two tags, and those with one tag were given another. Each tag was attached to a front flipper (fig. 9). Table A-20 gives

[5] Reference to trade names in this publication does not imply endorsement of commercial products.

the number, by area, of seals tagged at age 1 and older in 1969.

Raymond E. Anas

Recoveries of Marked Seals

This section includes the number of marked animals recovered in 1969, an analysis of tag loss, and the value of tags versus other marks.

Marked seals.—Male seals marked on the Pribilof Islands in previous years and recovered there in 1969 included 2,458 that had been single tagged or marked as pups (table A-21) and 1,093 that had been double tagged at age 1 or older (table A-22). Information is incomplete for 165 additional males that had been tagged at age 1 or older; the ages of 56 animals could not be determined because the heads or flippers were separated from the carcasses during the skinning process and 109 seals had lost both tags.

Thirty-seven seals tagged as pups by Soviet biologists were killed on the Pribilof Islands in 1969 (table A-23).

Alton Y. Roppel

Tag loss.—All seals that are tagged are given an additional mark or tag to decrease loss of their identity. When we recover double-marked animals in the kill, we record the loss of tags and later calculate the rate of tag loss (tables 6 and 7). Although the rate for most tag series has been greater than 0.3, those for the last four series (1T, 2T, 1U, and 2U) applied to males older than pups have been relatively low (<0.1, <0.1, <0.1, and 0.14, respectively) (table 7).

The rate of tag loss varies for several reasons, the most obvious of which have been quality and application of tags, and differences in the ages of animals tagged.

Ancel M. Johnson

Table 6.--Summary of tag loss for male seals tagged as pups, tag series Q through T, Pribilof Islands, Alaska

Year and tag series	Age at recovery	St. Paul Island				St. George Island			
		Tagged seals (a)	Lost-tag seals (b)	Total (a)+(b)	Ratio (b)/[(a)+(b)]	Tagged seals (a)	Lost-tag seals (b)	Total (a)+(b)	Ratio (b)/[(a)+(b)]
	Years	Number				Number			
1964									
Q	2	121	60	181	0.33	10	21	31	0.68
Q	3	1,225	558	1,783	0.31	338	89	427	0.21
Q	4	582	272	854	0.32	160	36	196	0.18
Q	5	64	43	107	0.40	26	1	27	0.04
Total		1,992	933	2,925	0.32	534	147	681	0.22
1965									
R[1/]	2	36	56	92	0.61	2	6	8	0.75
R	3	358	177	535	0.33	24	29	53	0.55
R	4	191	159	350	0.45	5	4	9	0.44
Total		585	392	977	0.40	31	39	70	0.56
1966									
S	2	35	22	57	0.39	6	10	16	0.62
S	3	285	283	568	0.50	58	13	71	0.18
Total		320	305	625	0.49	64	23	87	0.26
1967									
T	2	76	19	95	0.20	9	4	13	0.31

1/ No R-series tags were applied to seals on St. George Island.

Table 7.—Summary of tag loss for male seals tagged at age 1 or older, Pribilof Islands, Alaska

Tag series	Time elapsed since tagging	Both tags recovered	One tag lost	Incidence of tag loss (p)[1]
	Years	Number	Number	
2S	1	320	399	0.38
2S	2	45	63	0.41
2S	3	4	3	0.27
Total		369	465	0.39
2T	1	404	30	0.04
2T	2	261	51	0.09
Total		665	81	0.06
2U	1	332	108	0.14
1R	1	35	21	0.23
1R	2	105	113	0.35
IR	3	31	35	0.36
1R	4	3	4	0.40
Total		174	173	0.33
1S	1	77	51	0.25
1S	2	132	150	0.36
1S	3	39	54	0.41
Total		248	255	0.34
1T	1	84	7	0.04
1T	2	177	42	0.11
Total		261	49	0.04
1U	1	59	12	0.09

[1] $p = \frac{n_1}{2n_2+n_1}$; where n_1 = number recovered with one tag lost; n_2 = number recovered with no tag loss.

Tags vs. other marks.—Tag loss and mortality of tagged animals (greater than that of untagged animals) have shown that the cattle-ear tag is not ideal for marking seals. In 1965 and 1966, some pups were marked by removing part of a flipper and others were marked by tagging (table A-17) to determine if "flipper marks" were better. Table 8 gives the recoveries of males from these two year classes taken in the kill since 1967.

In 1968 the recovery rate for seals marked by removing part of a flipper was 1.17 times that of tagged animals for the 1965 year class. Data collected in 1969 from the 1965 year class again reflected a higher recovery rate for flipper marks. Data for the 1966 year class, however, show a higher recovery rate for tagged animals. Why the data for the two year classes are contradictory is not known. Thus, no conclusion can be made at this time on the relative effectiveness of the two methods of marking. The recovery of 4-year-old males in 1970 from the 1966 year class will give additional information.

Ancel M. Johnson

POPULATION ESTIMATES

The number of animals in various segments of the fur seal population is estimated from mark-recapture data. In 1969, we made estimates of the number of pups born each year from 1964 to 1967 and in 1969; the number of yearling males in the years 1965 to 1968; the number of 2-year-old males in 1966, 1967, and

Table 8.—Summary of recoveries of seal pups, year classes 1965-66, marked by two methods, Pribilof Islands, Alaska

Year class	Method of marking		Seals recovered at age: 2	3	4	Total	Recovery rate (Not percent)
			Number				
1965	Effective tags:	10,000	100	588	359	1,047	0.105
	Marks:						
	RH1[1]	10,080	72	709	393	1,174	0.116
	RFV[2]	10,007	94	673	385	1,152	0.115
1966	Effective tags:	12,499	73	639	...	712	0.057
	Marks:[3]						
	RH3 and LH2	12,081	45	519	...	564	0.047

[1] Tip of first digit of right hind flipper sliced off.
[2] V-notch cut into edge of right front flipper near tip.
[3] Tip of third digit right hind flipper and second digit left hind flipper sliced off.

1968; and the number of 3-year-old males remaining after the kill in 1966. All estimates except that of the number of pups born in 1969 are based on marked male seals recovered in the kill. The number of pups born in 1969 was estimated by shearing and sampling live pups in August.

Number of Seal Pups Born

Male seals marked as pups and recovered during the kill in 1969 provided a basis for making estimates of the number of pups at the time of marking for year classes 1963-67 (table 9). Some pups of the 1965 and 1966 year classes had been marked by tagging and others had been marked by removing part of a flipper (table A-17). Separate population estimates for year classes 1965-66 were made on the basis of recoveries from each group of marks. For the 1965 year class, the estimate based on tag recoveries was only slightly higher than the two estimates based on recoveries of seals marked by removing part of a flipper.

Table 9. --Estimates of the seal pup population, year classes 1963-67, at time of marking from recoveries of marked male seals in ages 2 to 6, Pribilof Islands, Alaska

Year class	Age	Killed (C)	Marked (M)	Recovered (R)	Estimate of population at time of marking 1/ $(\hat{N})$ 2/
	Years			Number	
1963	6	238	3/ 24,971	18	314,121
1964	5	2,149	3/ 24,991	134	398,021
1965	4	12,769	4/ 10,007	385	331,094
1965	4	12,769	5/ 10,080	393	326,737
1965	4	12,769	3/ 10,000	359	354,722
1965	4	12,769	6/ 30,087	1,137	337,631
1966	3	20,471	3/ 12,499	639	399,844
1966	3	20,471	7/ 12,078	519	475,541
1966	3	20,471	6/ 24,577	1,158	434,134
1967	2	3,051	3/ 12,472	108	349,244

1/ Estimates do not include counts of dead pups.

2/ $\hat{N}=\frac{(C+1)(M+1)}{(R+1)}$

3/ Marked by tagging.

4/ Marked by cutting a V-notch into the leading edge of the right front flipper.

5/ Marked by removing the tip of the first digit on the right hind flipper.

6/ Marked seals of the year class combined.

7/ Includes 9,578 seals marked by removing the tip of the third digit on the right hind flipper and 2,500 marked by removing the tip of the second digit on the left hind flipper.

An estimate of the size of the 1966 year class based on recoveries of males that had been tagged, however, was less than the estimate from recoveries of animals with part of a flipper removed. Why this difference should have occurred is not apparent.

Nearly all mortality of pups on land occurs before marking. Therefore, the total number of pups born is estimated by adding the count of dead pups to the estimate of the number of pups at the time of marking (table 10). The estimated number of pups born decreased from 643,000 in 1960 to 392,000 in 1965, then increased to 461,000 in 1966. The 1966 estimate, however, should be considered preliminary because it is based only on recoveries at age 3.

The number of pups born (exclusive of those that died on land) on St. Paul Island in 1969 was estimated by shearing and sampling live pups (Chapman and Johnson, 1968) in early August (table 11). Most of the mortality on land occurs before this date.

The total number of pups born on each rookery since 1963 was determined by adding the count of dead pups to the estimate from shearing (table 12). The estimates fluctuated moderately around a mean of 278,000 from 1963 to 1966, before decreasing to 233,000 in 1969. Estimates were made for only a few selected rookeries in 1967 and 1968.

The number of pups born in 1966 was estimated for each rookery on St. Paul and St.

Table 10. --Estimates of the seal pup population, year classes 1960-66, at time of tagging, from recoveries of marked male seals in ages 3 and 4, and the count of dead pups, Pribilof Islands, Alaska

Year class	Estimated pups alive at time of tagging	Count of dead pups	Total pups born
	Number	Number	Number
1960	568,000	75,000	643,000
1961	489,000	71,000	560,000
1962	430,000	54,000	484,000
1963	407,000	39,000	446,000
1964	395,000	25,000	420,000
1965	1/ 346,000	46,000	392,000
1966	1/ 434,000	27,000	461,000

1/ Estimate based on combined recoveries of males marked by tagging and by removing parts of flippers.

Table 11.--Estimates of the seal pup population, [1] year class 1969, at time of shearing, St. Paul Island

Rookery	Pups sheared	First sampling period, 12-13 August				Second sampling period, 22-23 August				Mean of estimates
		Counted			Estimated pup population at time of shearing	Counted			Estimated pup population at time of shearing	
		Samples	Sheared	Total		Samples	Sheared	Total		
		Number								
Morjovi	1,694	66	224	1,650	12,478	48	110	1,200	18,480	15,479
Vostochni	3,658	121	344	3,025	32,167	107	277	2,675	35,325	33,746
Little Polovina	518	20	49	500	5,286	31	82	775	4,896	5,091
Polovina Cliffs	1,853	91	236	2,275	17,863	112	281	2,800	18,464	18,164
Polovina	378	27	74	675	3,448	29	72	725	3,806	3,627
Tolstoi	2,557	136	338	3,400	25,721	128	295	3,200	27,737	26,729
Zapadni	2,724	143	348	3,575	27,984	87	192	2,175	30,858	29,421
Little Zapadni	1,448	62	121	1,550	18,549	105	198	2,625	19,197	18,873
Zapadni Reef	460	17	35	425	5,586	22	71	550	3,563	4,574
Reef	2,903	110	310	2,750	25,752	96	245	2,400	28,438	27,095
Gorbatch	1,704	64	151	1,600	18,056	78	192	1,950	17,306	17,681
Ardiguen	472	12	61	300	2,321	18	44	450	4,827	3,579
Kitovi	1,146	61	184	1,525	9,498	53	124	1,325	12,246	10,872
Lukanin	384	14	32	350	4,200	16	30	400	5,120	4,660
Total	21,899				208,909				230,263	219,591

1/ Estimates do not include counts of dead pups.

Table 12.--Estimates of the number of seal pups born, [1] year classes 1963-69, from shearing and sampling, St. Paul Island

Rookery	Year class						
	1963	1964	1965	1966	1967[2]	1968[2]	1969
	Number						
Morjovi	19,600	19,600	18,900	20,900	-	18,200	16,200
Vostochni	39,800	45,400	39,900	51,600	-	37,500	35,400
Little Polovina	7,400	9,000	8,100	9,200	-	-	5,300
Polovina Cliffs	21,800	23,400	21,000	24,100	-	-	19,000
Polovina	5,400	5,900	6,300	6,000	-	-	4,000
Tolstoi	26,900	28,100	30,800	30,400	35,700	-	29,500
Zapadni	37,000	37,500	32,400	40,900	-	-	31,700
Little Zapadni	16,400	18,200	17,700	24,600	-	-	19,700
Zapadni Reef	6,900	6,900	6,100	5,400	-	5,200	4,800
Reef	38,700	41,700	39,500	38,500	33,500	27,900	28,500
Gorbatch	[3] 25,200	25,200	20,900	22,400	-	-	18,500
Ardiguen		2,900	2,700	2,900	-	-	3,700
Kitovi	11,700	14,600	14,100	14,400	-	-	11,500
Lukanin	5,700	5,500	6,400	7,600	-	-	5,100
St. Paul Island total	262,500	283,900	264,800	298,900	-	-	232,900

1/ Estimates include the counts of dead pups.

2/ Pups were sheared and sampled only on selected rookeries.

3/ In 1963, estimates were combined for Gorbatch and Ardiguen Rookeries.

Table 13.--Estimates of the seal pup population, year classes 1961-66 and 1969, for St. Paul Island from shearing and sampling, and for the Pribilof Islands, Alaska, from an extrapolation[1/]

	Year class						
	1961	1962	1963	1964	1965	1966	1969
Estimate for St. Paul Island at time of marking[2/]	276,000	231,800	229,900	262,300	225,700	277,500	219,600
Dead pups counted on St. Paul Island	60,800	47,500	34,200	22,700	41,100	22,500	13,900
Number of pups born on St. Paul Island	336,800	278,300	264,100	285,000	266,800	300,000	233,500
Estimate for Pribilof Islands	437,800	361,800	343,300	370,500	346,800	390,000	303,500

1/ Estimate for the Pribilof Islands is 1.30 times the estimate for St. Paul Island. The factor 1.30 is based on 1966 data when pup population estimates were made on all rookeries of St. Paul and St. George Islands and Sea Lion Rock.

2/ Estimates do not include the counts of dead pups.

George Islands and Sea Lion Rock. Estimates were based on shearing and sampling and counts of dead pups. The proportion born on St. Paul Island was 0.77. For 1961-65 and 1969 the number of pups born was estimated on St. Paul Island only. The estimate for the Pribilof Islands, including St. George Island and Sea Lion Rock, was calculated by multiplying the estimate for St. Paul Island by 1.30 (table 13).

The estimated number of pups born, based on tag recoveries and on shearing and sampling, are compared in table 14 for year classes 1961-66. The estimates from tag recoveries have always been higher than those from shearing and sampling. Differences between estimates from the two methods decreased from over 100,000 to about 50,000 for year classes born after 1963. The decrease may be partially explained by more equitable distribution of the shearing effort after 1963, which was accomplished by dividing the rookeries into units, recording the counts of class 3 males by unit, and applying the shearing effort on the basis of these counts.

The actual number of pups born on the Pribilof Islands is probably between estimates from the two methods. From 1961 to 1966 the number of pups born decreased from nearly 500,000 to about 400,000. Our estimate of 303,000 in 1969, based on shearing and sampling, indicates that there probably has been a further decrease since 1966.

Ancel M. Johnson

Number of Male Seals Ages 1 to 2 Years

We have marked males from several recent year classes when the seals were older than

Table 14.--Comparison of estimates based on tag recoveries with estimates based on shearing and sampling, for number of seal pups born, year classes 1961-66, Pribilof Islands, Alaska

Year class	From tag recoveries (N_t)	From shearing and sampling (N_s)	Ratio of the estimate (N_s/N_t)
	Number	Number	
1961	560,000	438,000	0.78
1962	484,000	362,000	0.75
1963	446,000	343,000	0.77
1964	420,000	370,000	0.88
1965	392,000	347,000	0.89
1966	461,000	390,000	0.85

1/ Estimates include counts of dead pups.

pups by tagging small animals in late September and early October (see section on marking). Population estimates based on recoveries of tagged animals subsequently killed on the Pribilof Islands are discussed in this section.

Our data are not complete for all males recovered that were or had been tagged. We could not, for example, determine the age of a seal after the head (and canine teeth, on which age is based) had become separated from the carcass. The ages of seals that had lost both tags (as recognized by a tag scar on each front flipper) were determined, but there was no way to ascertain the tag series applied to these animals. Therefore, we adjusted for these incomplete data before making population estimates (1) by distributing animals of unknown ages within each tag series according to the age distribution for the series and (2) for double-tag loss by adjusting the number of tags of each series applied. The latter adjustment differed from that used in 1968 (Marine Mammal Biological Laboratory, 1970b) when males that had lost both tags were distributed in proportion to the number with complete data by age and tag series. The proportion of the animals that were actually age 1 when tagged was determined from the age distribution of the tagged animals recovered. For example, of 809 males believed to be yearlings and marked with 1-R series tags in 1965, 301 were recovered through 1969. Of the latter, 280 were actually age 1 when tagged. Thus, the estimated number of yearling males tagged in 1965 is $(280/301)(809) = 753$. If we add 64 animals that had been tagged as pups in 1964 and were given another tag in 1965, the total number of males that were actually yearlings was 817. The rate of tag loss among 1R-series recoveries was 0.33. To compensate for loss of both tags, we adjusted the number of yearling males tagged by multiplying by the factor $1-(0.33)^2$. Therefore, 728 yearling males were effectively tagged with 1R-series tags in 1965. The number of effective tags is used for population estimates.

Population estimates based on recoveries of tags applied to males older than pups are given in tables 15 and 16. Except for 2T-series data, the estimates for a given tag series increase with an increase in age at recovery. Increased tag loss may be responsible for the apparent rise in the estimates, but the data in table 7 do not indicate that it has been increasing sufficiently to account for large decreases in recovery rates. Behavior, tag-caused mortality, and selection for tags during killing are other possible factors. Until we know what is causing a decrease in the recovery rate we can have little confidence in population estimates based on tag recoveries. Data to be collected in 1970 and 1971 from the 1965 and 1966 year classes may help us to understand why the recovery rates have changed.

Ancel M. Johnson

FORECAST OF THE KILL OF MALE SEALS IN 1970

Our forecasts of the male kill for 1966 and 1967 were extremely accurate, but subsequent forecasts have been less satisfactory. For example, our forecasts of 49,000 for 1968 and 57,000 for 1969 exceeded the actual kills by 5,000 and 18,000, respectively. We should, therefore, ask whether these errors represent chance variations in the forecast and merely reflect the fact that our methods of forecasting are still rather imprecise, or whether there has been a change in the relation of the kill to basic factors used in forecasting. The latter, if true, might have been caused by undetected climatic changes, an unanticipated result of our manipulation of the population, or a reduction in the amount of food available to the seals as a result of the vast trawl fishery that moved into the Bering Sea during the past decade.

A necessary condition for accurate forecasting is that we have observations of a factor or group of factors to be used as independent variables that accurately reflect survival of fur seals to age 3. Only the estimates from tags applied to yearling males seem to fall in this category. The variability in these estimates, however, and the small number of recoveries at age 2 decrease considerably the value of yearling tagging as a way to provide a substantial increase in forecasting accuracy. Therefore, unless the results from yearling tagging improve or we find additional ways to predict, it is unlikely that we will be able to forecast with confidence.

Table 15.--Estimates of the number of yearling male seals, year classes 1964-67, from recoveries of marked male seals, Pribilof Islands, Alaska

Year class and tag series	Year when killed	Age when killed	Killed (C)	Recovered 1/ (R)	Tagged 2/ (M)	Estimated yearlings at time of tagging $\left(\hat{N} - \frac{MC}{R}\right)$
		Years			Number	
1964					728	
1R	1966	2	3,533	40		64,301
1R	1967	3	34,613	222		113,506
1R	1968	4	16,912	64		192,374
1R	1969	5	2,149	7		223,496
1R	Pooled		57,207	333		125,065
1965					1,129	
1S	1967	2	2,940	88		37,719
1S	1968	3	22,978	263		98,639
1S	1969	4	12,769	91		158,420
1S	Pooled		38,687	442		98,818
1966					716	
1T	1968	2	2,040	63		23,185
1T	1969	3	20,471	198		74,026
1T	Pooled		22,511	261		61,754
1967					529	
1U	1969	2	3,051	35		46,113

1/ Number recovered includes those of unknown age.

2/ Number of marks applied adjusted to compensate for double tag loss and according to the error in determining age at time of tagging. See example in section "Number of male seals ages 1 to 2 years."

To determine if there is an indication of a change in the basic relationship between fur seals and their environment or other factors, we look first at the survival of males since 1961, based on comparable data (table 17). There has been no particular trend in the number of pups born each year since that year but, nevertheless, the percentage that survived through the first year of life has fluctuated widely. The percentage of the yearling group represented by the male harvest, however, has also been quite variable, ranging in the four available data points from 41.4 to 58.7. In addition, survival from birth to age 1 and from age 1 to ages included in the male harvest (2 through 5) are strongly negatively correlated ($r = -0.873$). This negative correlation could have a biological basis, but it is probably influenced largely by random errors in the yearling population estimate. This estimate appears in both survival percentages, as the numerator in the first and the denominator in the second. Moreover, the yearling estimate is subject to the usual sampling errors and also the possibility of errors made during determination of ages. In view of these circumstances, we should look at the relationship between the male harvest and the number of pups surviving their first summer. The percent survival (table 18) is the fraction of the pup population censused in August of their birth year that is represented by the harvest of males. Included in table 18 are two additional variables that have been used in forecasting — the mean annual air temperature for the 12-month period ending 30 June of the year of birth and the counts of dead pups.

These series are, of course, very short for use in empirical forecasting; the linear relation between air temperature and percent survival is rather poor ($r^2 = 0.175$) but that between the count of dead pups and percent survival is good ($r^2 = 0.773$). If the latter relation is calculated, one obtains

$$S = 37.9\text{-}0.2D$$

Table 16. --Estimated number of 2- and 3-year-old male seals, year classes 1963-66, from recoveries of marked male seals, Pribilof Islands, Alaska

Year class and tag series	Age when tagged	Age when killed	Killed (C)	Recovered[1] (R)	Tagged[2] (M)	Estimated seals at time of tagging ($\hat{N} = \frac{MC}{R}$)
	Years	Years	Number			
1963					275	
2S	3	4	15,523	181		23,585
2S	3	5	1,935	11		48,375
2S	3	6	238	1		65,450
2S	3	Pooled	17,696	193		25,215
1964					965	
2S	2	3	34,613	573		58,292
2S	2	4	16,912	101		161,585
2S	2	5	2,149	6		345,631
2S	2	Pooled	53,674	680		76,170
1965					1,141	
2T	2	3	22,978	409		64,102
2T	2	4	12,769	293		49,725
2T	2	Pooled	35,747	702		58,102
1966					1,346	
2U	2	3	20,471	405		68,034

1/ Numbers recovered include those of unknown age.

2/ Number of tags applied adjusted to compensate for double tag loss and according to the observed age distribution of tagged animals when recovered. See example in section "Number of male seals ages 1 to 2 years."

Table 17. --Survival of male seals, year classes 1961-66, Pribilof Islands, Alaska

Year class	Males born[1]	Males alive at time of shearing in early August[1]	Males alive in September 13 months later[2]		Males killed at ages 2 to 5	Proportion of yearling group represented by the kill
	Thousands	Thousands	Thousands	Percent	Thousands	Percent
1961	218.9	183.4	81.5	37.2	47.8	58.7
1962	180.9	154.0	79.2	43.8	44.1	55.7
1963	171.6	152.0	-	-	50.0	-
1964	185.2	172.8	125.1	67.5	57.3	45.8
1965	173.4	150.2	98.8	57.0	3/ 40.9	41.4
1966	195.0	181.3	4/ 61.7	34.0	-	-

1/ Taken from table 13 but converted to an estimate for males by dividing the totals given there by two on the assumption that the sex ratio at birth and among the dead pups on the rookeries is 1:1.

2/ Taken from table 15 of this report and table 18 of "Fur seal investigations, 1967" (Marine Mammal Biological Laboratory, 1970a).

3/ The kill of 5-year-old males estimated to be 2,000 and added to the observed totals at age 2 to 4.

4/ Based on recoveries through age 3 and hence not strictly comparable with other figures in this column.

Table 18.--Fraction of the seal pup population in August of their birth year that is represented by the harvest (survival) of male seals on the Pribilof Islands at ages 2 to 5 from the same year class, and the mean annual air temperature and count of dead pups on St. Paul Island

Year class	Pribilof Islands	St. Paul Island	
	Survival	Deviation of the mean annual air temperature from 32° 1/	Count of dead pups
	Percent	Degrees F.	Thousands
1961	26.1	18	60.8
1962	28.6	21	47.5
1963	32.9	28	34.2
1964	33.2	15	22.7
1965	27.2	12	41.1

1/ (Mean annual air temperature for 12-month period ending 30 June of the birth year-32° F.) X 10.

where S = percent survival
D = dead pup count

For the 1966 year class, D = 22.5, so that $\hat{S}$ = 33.4. According to our estimate of its size (277.5 thousand) on St. Paul Island in August of the year of birth, the 1966 year class should yield a total kill of 46.3 thousand males, i.e., (0.5) (277.5) (0.334). Because the St. Paul Island kill from this year class to date is 19.5 thousand (17,826 were taken at age 3), the balance to be taken at age 4 is 26.8 thousand minus a few hundred seals that will be killed in 1971 at age 5. The kill from a year class at age 4 has exceeded the number taken at age 3 only once since 1947, when we began determining the ages of seals — 30.7 and 31.4 thousand, respectively, were taken at ages 3 and 4 from the 1952 year class. Even so, excessive numbers of 4-year-old males from the 1952 year class were taken only because the kill in 1956 was extended to 15 August, whereas the kill at age 3 in 1955 ended 31 July. For the past 10 year classes for which complete data are available (1956-65), the ratio on St. Paul Island of the kill from a year class at age 3 to the kill at ages 3 and 4 has averaged 0.666. During the same period, the ratio reached a low of 0.576. The standard deviation of these 10 ratios is 0.07. If the estimate (46.3 thousand) given above for the harvest from the 1966 year class is correct, an age 3 to age-3-plus-4 ratio of about 0.41 is implied, which is about 3.6 standard deviations from the mean. Although the mean and standard deviation are estimates, a ratio of 0.41 is improbable and the estimate must therefore be discarded. Consequently, we will not use this method to forecast the 4-year-old kill but will use two methods that for 1968 were demonstrated to be the best (Marine Mammal Biological Laboratory, 1970b).

Forecast of the Kill of 4-Year-Old Male Seals

Three- and four-year-old seals dominate the harvest of males, and the ratio between these two age groups is about 2:1. This ratio could be used to provide a forecast of the kill of 4-year-old males that would be relatively satisfactory. We can, however, try to improve the forecast by considering the timing of the 3-year-old returns. If the 3-year-olds have peaked early, we can expect a small remaining balance of the year class for killing the following year at age 4 because fewer seals will have returned after the end of the kill. In earlier years, we have measured timing by the mean "round" of killing, but because the round system has since been modified, we now use a median date of return. We have also adjusted the data to account for different starting dates but in this forecast we have entered the starting date as a third predictor variable. This variable contributes little to the total variation explained but has been retained nevertheless. We still must adjust the kill of males because of variations in ending dates of the kill.

Regression of the kill of male seals at age 4 on the kill at age 3, median date of the kill at age 3, and the starting date of the kill. — The regression equation derived from adjusted data given in table 19 is

$$Y = -8.57 + 0.64X_1 + 3.16X_2 - 0.31X_3.$$

For the 1966 year class, $X_1 = 17$, $X_2 = 3.5$, $X_3 = 3$, hence, $\hat{Y} = 12.4$ thousand.

The standard error of this forecast is 3.8 thousand. If we adjust this prediction for the kill in August 1969 and a potential kill in August 1970, it yields a final estimate of about 12.0

Table 19.--Data for regression of the kill of 4-year-old male seals on the kill of 3-year-old male seals, median date of the kill of 3-year-old male seals, and starting date of the kill, year classes 1952-65, St. Paul Island

Year class	From starting date to 31 July (X_1)	Median date (days after 15 July) (X_2)	Starting date (days after 22 June) (X_3)	Kill of 4-year-olds[1/] (Y)
	Thousands			Thousands
1952	31	5.7	0	29
1953	27	4.6	5	17
1954	17	3.6	5	11
1955	27	1.5	5	11
1956	10	3.4	5	3
1957	15	4.5	5	20
1958	30	5.3	10	27
1959	20	3.8	10	17
1960	12	5.1	10	12
1961	18	4.3	9	14
1962	12	6.9	15	16
1963	21	5.4	15	14
1964	22	3.0	5	16
1965	17	3.6	4	12

1/ Kill of 4-year-old males to 31 July plus 80 percent of the kill of 3-year-old males in August of the previous year.

thousand for the kill of 4-year-old males on St. Paul Island in 1970.

Estimate of the kill of 4-year old male seals from the yearling male seal population estimate.—If an accurate estimate of the number of yearling males can be made and if the largest and most variable component of mortality occurs during the first year of life, this estimate should be the best forecasting tool. Whereas the estimates of yearling males from the combined kill of seals from each year class have seemed reasonable and consistent, the estimates based on tags recovered in different years for the same year class are inconsistent. For example, estimates based on tag recoveries from 2-year-olds have been unreasonably low. Also, estimates of each year class from returns of tags at successive ages (2, 3, 4, and 5) have almost consistently shown an increasing trend, often with very large increases.

Two estimates of the size of the 1966 year class at age 1 are available for predicting the kill of 4-year-old males in 1970, one based on 2-year-old tag recoveries and another on recoveries at age 3. Because our estimates from the latter have been closest to estimates based on data combined from ages 2 and 3, we have used them in the following prediction:

The estimated regression based on data in table 20 is

$$K_{3+4} = 0.376Y$$

where

K_{3+4} = kill of 3- and 4-year-old males on St. Paul Island

Y = estimate of yearling population, Pribilof Islands.

For the 1966 year class $Y = 74.0$ and hence $K_{3+4} = 27.8$ thousand. Because the kill in 1969 was 17.8 thousand, the estimated 4-year-

Table 20.—Observed kill of 3- and 4-year-old male seals, St. Paul Island, and estimated number of yearling male seals, Pribilof Islands, Alaska, year classes 1961-63 and 1965

Year class	Estimate of yearling male seals, Pribilof Islands	Kill of 3- and 4-year-old male seals, St. Paul Island
	Thousands	Thousands
1961	76.4	34.5
1962	86.2	31.2
1963	113.5	40.3
1965	98.6	29.3

old male kill in 1970 is 10.0 thousand. The standard error of this forecast is 7.2 thousand.

In our forecast for 1969 (Marine Mammal Biological Laboratory, 1970b), we gave two estimates of the 3- and 4-year-old male kill to be expected from the 1966 year class, one of 46.0 thousand (based on a temperature regression) and another of 46.8 thousand (based on a regression in which pup weight and the dead pup count were used). Like the estimate given earlier, the above estimates imply a 4-year-old male seal kill in 1970 of 28 to 29 thousand and a ratio of less than 0.40 between the kill at age 3 and the combined kill at ages 3 and 4. Again, this situation seems totally improbable and hence the forecasts by these methods must be discarded.

Combined estimates of the kill of 4-year-old male seals on St. Paul Island.—The several estimates and the best weighted combinations are:

Method or basis	Estimate	Standard error
	Thousands	*Thousands*
Regression on kill at age 3, median date of kill at age 3, and starting date of kill	12.0	3.8
Yearling male seal population estimate	10.0	7.2
Weighted average	11.6	3.4

Forecast of the Kill of 3-Year-Old Male Seals

Variables that have been used to forecast the kill of 3-year-old males are counts of dead pups, weights of pups, mean air temperature, and estimates of the number of yearling males derived from tag returns at age 2. In previous studies the regression in which weights of pups and air temperatures are used as predictor variables have been handled separately because the series of available data were of different lengths. The length of the data series on weights of pups, however, is now sufficiently long; moreover, it is likely that the effect of air temperature at present population levels may be different from that obtained in the early 1950's. For these reasons, a multiple regression equation has been calculated in which these variables are used for year classes 1957-65. Table 21 shows the basic data.

Table 21.—Weights of seal pups, mean air temperature, and observed kill of 3- and 4-year-old male seals, year classes 1957-65, St. Paul Island

Year class	Mean weight of unmarked pups in autumn (W)	Deviation of the mean annual air temperature from 32° (in tenths of a degree above 32°) (T)	Kill of males at ages 3 and 4 (K)
	Kg.	Degrees F.	Thousands
1957	8.7	23	40
1958	11.4	34	63
1959	9.4	33	41
1960	9.8	26	25
1961	8.5	18	35
1962	9.2	21	31
1963	8.9	28	37
1964	9.1	15	51
1965	9.5	12	29

Regression of the kill of male seals at age 3 on weights of pups and on air temperature.—The regression equation derived from these data is

$$K = 5.9W + 0.44T - 37.7.$$

For the 1967 year class, $W = 10.23$, $T = 48$, so that $\hat{K} = 43.8$. We use this method to estimate the total kill at ages 3 and 4. If the percentage of this kill taken at age 3 is 66.6 (the average for the past 10 complete age classes), we predict a kill of 28.9 thousand at age 3. The standard error of this forecast is 18.9 thousand, which is unusually large because weights of pups and air temperatures for the 1967 year class deviate considerably from the mean. In fact, the mean air temperature for the 1967 year class is the highest so far observed, which makes its validity as a predictor variable even more doubtful than usual.

Estimate of the kill of 3-year-old male seals from the yearling male seal population estimate.—To use the yearling data, it is necessary to work with the estimates based on tag recoveries at age 2. These estimates are biased, but if the bias is of the same order of magnitude they represent a usable predictor variable. The basic data are shown in table 22.

Table 22.--Estimated number of yearling male seals and kill of 3-year-old male seals, year classes 1961-62, and 1964-66, St. Paul Island

Year class	Estimated number of yearling males from recoveries at age 2 (Y_2)	Kill of 3-year-old males on St. Paul Island (K_3)	Ratio (K_3/Y_2)
	Thousands	Thousands	
1961	27.1	22.5	0.83
1962	33.8	19.0	0.56
1964	64.3	27.0	0.42
1965	37.7	18.7	0.50
1966	23.2	17.8	0.77
Mean			0.616

The estimated regression is $K_3 = 0.616Y_2$. For the 1967 year class, $Y_2 = 46.1$ and $\hat{K}_3 = 28.4$; the standard error of this forecast is 5.7 thousand. In calculating the standard error, we have considered the error in estimating the regression equation and Y_2. The latter error is approximated by comparing estimates of the number of yearlings from recoveries at age 3 with those from combined recoveries. The standard error may in fact be slightly higher than 5.7 thousand, because the series of comparisons is extremely short (1961-65, except 1963).

Some current estimates of the yearling population differ from those used in 1968 because we now have more data with which to determine the true age composition of seals selected as yearlings on the basis of size.

Estimate of the kill of 3-year-old male seals from the count of dead pups and the pup population estimate.—Earlier in this section, we gave the survival equation

$$S = 37.9 - 0.2D,$$

where

S = percent survival from age 0 (August) to the male harvest (combined kill ages 2 to 5),

D = dead pup count (thousands), St. Paul Island.

For 1967, D = 17.4, so that $\hat{S} = 34.4$. We did not estimate the fall pup population for all rookeries in 1967, but we can reasonably assume that the population levels of recent years have been similar and that variations in the estimates have reflected variability in sampling. It is valid, therefore, to consider the average of recent estimates an estimate of the pup population in August 1967. Also, the variance of recent estimates may be considered a measure of variability in population sizes. The average of five available estimates (1963-66 and 1969) for St. Paul Island is 243.0 thousand (standard deviation 25.4 thousand). If we apply the estimate of $\hat{S}$ to half this average (only half are males), we estimate the male kill at ages 2 to 5 from the 1967 year class as 41.8 thousand. Of this number, 2.6 thousand were taken as 2-year-olds in 1969. If we estimate that 1,400 will be taken as 5-year-olds and allocate the remainder to ages 3 and 4 on a 2:1 basis, the estimated 3-year-old kill for St. Paul in 1970 by this method is 25.2 thousand. We must again neglect the shortness of the series involved in these calculations but by methods similar to those we applied in the last estimate, i.e., allowing for error in $\hat{S}$ and the pup population estimate, we calculate a standard error of 10.6 thousand.

Combined estimates of the kill of 3-year-old male seals on St. Paul Island.—The several estimates and their standard errors are:

Method or basis	Estimate	Standard error
	Thousands	*Thousands*
Air temperature and pup weight regression	28.9	18.9
Yearling male seal population estimate	28.4	5.7
Survival estimate determined from dead pup count applied to August pup population estimate	25.2	10.6
Weighted average	27.8	4.9

Forecast of the Total Kill of Male Seals

Table 23 gives the forecast of the total kill of male seals for both islands, by age. The estimated kill at ages 2 and 5 is the average of recent years. The extrapolation to St.

Table 23.--Forecast of the kill of male seals in 1970, by age, Pribilof Islands, Alaska

Island	Age			Total
	2 and 5	3	4	
	Number			
St. Paul	3,500	27,800	11,600	42,900
St. George	900	7,000	2,900	10,800
Total	4,400	34,800	14,500	53,700

George Island is based on the assumption that the kill on St. Paul Island will be 80 percent of the total (average of 1955-64 year classes was 79 percent).

Table 24 compares the forecast for 1969 with the actual kill. As noted in the introduction to this section, this forecast was very poor, erring in overestimating the kill of 3- and 4-year-olds. Actually the forecast of the kill at age 3 erred by only 1.23 times the standard error, which unfortunately is to be expected occasionally. The forecast for the kill of 4-year-olds on St. Paul Island, however, erred by 7.7 thousand, or about 4.2 standard errors of our estimate in the forecast for 1968. Apparently our knowledge of basic biological factors is inadequate with regard to forecasting the survival of fur seals, or, as mentioned earlier, we are not measuring the appropriate variables with required accuracy.

Douglas G. Chapman

SPECIAL STUDIES

This section includes studies of fur seal biology that are carried on in addition to continuing studies described in the main body of this report.

Activity of Young Male Seals on Land

Studies of the activity of young males while they are on the hauling grounds of the Pribilof Islands will provide information useful for efficiently harvesting the population. Marking individual seals with tags and radio transmitters (telemetry) can furnish this information.

Tagging.—We marked male seals $\geq$ 2 years old (most were 3 and 4 years old) on St. Paul Island with paired but uncoated X-series tags in 1968 and XA-series tags in 1969. The tags were attached to the front flippers of these seals (fig. 9) on 24-25 June and 10-11 and 18 July in 1968, and on 20-24 June and 1-5 and 14-17 July in 1969. We drove some seals especially for tagging, but selected most of the animals from among seals routinely driven for killing. These tagged seals were killed when they appeared in drives subsequent to tagging, and the age of each was determined from a canine tooth collected at death.

Table 24.--Forecasted and actual kill of male seals, by age, Pribilof Islands, Alaska, 1969

Island	Age			Total
	2 and 5	3	4	
	Number			
St. Paul				
Actual	4,109	17,826	10,565	32,500
Forecast	3,300	23,600	18,300	45,200
St. George				
Actual	1,091	2,645	2,204	5,940
Forecast	900	5,900	4,600	11,400
Combined				
Actual	5,200	20,471	12,769	38,440
Forecast	4,200	29,500	22,900	56,600

We also tagged 40 seals on St. Paul Island with paired, white-coated (fuse-bond plastic) X-series tags 30 June to 3 July and 14-17 July in 1969. If these seals appeared in subsequent drives, their tag numbers were to be recorded, but they were not to be killed until near the end of the season. Some of the animals, however, were taken prematurely.

Male seals tagged in 1968 and recovered in 1968 and 1969.—Of 334 males $\geq$ 2 years old tagged on St. Paul Island in 1968, 67.7 percent were recovered in 1968 and 12.8 percent in 1969 (table 25). The recovery rates of seals tagged on inaccessible hauling grounds in June and on accessible hauling grounds in July were lower (70.7 and 77.0 percent, respectively) than a rate of 87.3 percent for seals tagged in June on accessible hauling grounds.

All of the seals tagged in 1968 and recovered in that year had retained both tags; 8 of 43 recovered in 1969 had lost 1 tag. Tag loss, therefore, was 1.5 percent.

Male seals tagged in 1969 and recovered in 1969.—Of 555 effective tags applied to male seals ≥ 2 years old on St. Paul Island in 1969, 68.5 percent were recovered (table 26). Although 600 males were tagged, only 555 were effective because some of the seals lost their tags. Two tagging pliers were found to be faulty after the June 1969 tagging period. Tag losses were: 18, 15, 2, and 40 percent on seals tagged on four hauling grounds in June 1969; 4, 1, 2, and 3 percent on seals tagged 1-5 July; and 1, <1, 1, and 5 percent on seals tagged 14-17 July.

The interval between tagging and recovery of tags ranged from 1 to 40 days. Forty-six percent of the seals tagged were recovered within 7 days, after which the recoveries dropped sharply (table 27). On the basis of a standard recovery interval of 15 days (the interval between the last day of tagging on 17 July and the end of the kill on 1 August), 53, 54, and 56 percent of the seals tagged 20-23 June, 1-5 July, and 14-17 July, respectively, were recovered in 1969.

Tagged seals showed a strong tendency to return to the hauling ground of tagging — 74

Table 25. --Percentage recovery of tags applied to male seals ≥2 years old 24 June to 18 July 1968 and recovered in 1968 and 1969, St. Paul Island

Date of tagging	Hauling ground of tagging[1/]	Year recovered		Total
		1968	1969	
		----Percent----		Percent
24 June	REEF	84.0	0.0	84.0
25 June	NEP(west)	86.0	0.0	86.0
25 June	ARD	62.5	0.0	62.5
25 June	ZAP PT	68.0	8.0	76.0
25 June	ZAP	84.0	8.0	92.0
10 July	NEP(east)	42.0	38.0	80.0
11 July	TZR	56.0	18.0	74.0
18 July	REEF	53.5	20.9	74.4
Total		67.7	12.8	80.5

1/ REEF=Reef; NEP(west)=west side of Northeast Point; ARD=Ardiguen; ZAP PT=Zapadni Point; ZAP=Zapadni; NEP(east)= east side of Northeast Point; TZR=Tolstoi-Zapadni Reef. Ardiguen and Zapadni Point hauling grounds are inaccessible and cannot be routinely driven for killing. All other hauling grounds listed are accessible.

Table 26. --Uncoated tags applied to male seals ≥2 years old 20 June to 17 July 1969 and recovered in 1969, St. Paul Island

Date of tagging	Hauling ground of tagging	Effective tags[2/] (XA-series)	Island and hauling ground of recovery[1/]											Total	
			St. Paul							St. George					
			NEP(west)	NEP(east)	ZAP-1	TZR	REEF	L-K	POL	NOR	EAST	ZAP-2	STAR		
		Number	----------Number----------											Number	Percent
20 June	NEP(east)	49	5	26	-	-	3	-	1	-	-	1	-	36	73.5
20 June	POL	43	-	1	3	-	6	1	24	1	-	-	-	36	83.7
23 June	REEF	41	-	-	2	-	27	-	-	-	1	-	-	30	73.2
23 June	ZAP-1	30	-	2	26	-	3	-	-	-	-	-	-	31	>100.0
24 June	ARD	2	-	-	-	-	-	-	-	-	1	-	-	1	50.0
1 July	ZAP-1	48	2	1	24	6	4	-	-	-	-	-	1	38	79.2
2 July	REEF	49	-	1	2	3	20	1	-	1	2	-	-	30	61.2
3 July	POL	49	-	1	-	-	-	-	35	-	-	-	-	36	73.5
5 July	NEP(east)	49	7	19	2	1	1	-	1	1	-	-	-	32	65.3
14 July	POL	49	-	4	3	-	1	2	11	-	-	-	-	21	42.9
15 July	NEP(east)	50	-	30	1	-	-	-	-	-	-	-	-	31	62.0
16 July	ZAP-1	3/48	-	-	20	7	4	1	1	-	-	-	-	33	68.7
17 July	REEF	48	-	-	5	2	17	1	-	-	-	-	-	25	52.1
Total		555	14	85	88	19	86	6	73	3	4	1	1	380	68.5

1/ NEP(east) = east side of Northeast Point; NEP(west) = west side of Northeast Point; ZAP-1 = Zapadni (St. Paul); TZR = Tolstoi-Zapadni Reef; REEF = Reef; L-K = Lukanin-Kitovi; POL = Polovina; NOR = North; EAST = East; ZAP-2 = Zapadni (St. George); STAR = Staraya Artil; ARD = Ardiguen.

2/ Effective tags = $(T)\left(1-\left[\frac{R_1}{2R-R_1}\right]^2\right)$.

where T = total number tagged
R_1 = number recovered with one tag
R = total number of tagged animals recovered.

3/ One seal double tagged with numbers 532 and 500, and one seal double tagged with numbers 535 and 536.

Table 27.--Number of days between tagging and recovery of uncoated tags applied to male seals ≥2 years old, St. Paul Island, 20 June to 17 July 1969

Date of tagging	Hauling ground of tagging[1]	Tag numbers[2] (XA-series)	Effective tags	Days to recovery and number of tagged seals recovered						Total tagged seals recovered
				1-7	8-14	15-21	22-28	29-35	36-43	
			Number	Number						Number
20 June	NEP(east)	101-150	49	18	2	6	6	2	2	36
20 and 23 June	POL	51-100	43	20	2	-	5	5	4	36
23 June	REEF	1-50	41	21	-	4	3	2	-	30
23 June	ZAP	151-200	30	20	1	2	4	3	1	31
24 June	ARD	201-202	2	-	-	1	-	-	-	1
1 July	ZAP	226-275	48	21	3	8	5	1	End of kill	38
2 July	REEF	276-325	49	21	2	2	2	3	-do.-	30
3 July	POL	326-375	49	28	-	6	2	-	-do.-	36
5 July	NEP(east)	376-425	49	14	10	3	5	End of kill	-do.-	32
14 July	POL	426-475	49	16	3	2	End of kill	-do.-	-do.-	21
15 July	NEP(east)	476-525	50	26	3	2	-do.-	-do.-	-do.-	31
16 July	ZAP	526-575	[3]48	31	2	-	-do.-	-do.-	-do.-	33
17 July	REEF	576-625	48	21	4	-	-do.-	-do.-	-do.-	25
Total			555	257	32	36	32	16	7	380
Percent of effective tags				46.3	5.8	6.5	5.8	2.9	1.2	

1/ NEP(east) = east side of Northeast Point; POL = Polovina; REEF = Reef; ZAP = Zapadni; ARD = Ardiguen.

2/ Seals were double tagged with paired numbers (1 and 1 on first seal, etc.).

3/ One seal double tagged with numbers 532 and 550, and one seal double tagged with numbers 535 and 536.

percent were recovered there (table 28). Only 9 of 380 tagged seals recovered were taken on St. George Island. The proportion of tagged 4-year-old males recovered on the hauling ground of tagging was higher than that of 3-year-old males, but not significantly so.

Discussion of tagging.—Eighty percent of the tags applied to seals in 1968 were recovered in 1968 and 1969. If additional tags are recovered in 1970, a utilization rate of slightly over 80 percent for these males is indicated. The percentage of seals recovered during the period in which they were tagged (20 June to 1 August) was similar in 1968 and 1969 ($P = 0.76$).

The proportions recovered of tags applied in late June of 1968 and 1969 and in mid-July of 1968 and 1969 to seals on accessible hauling grounds were nearly equal (fig. 11) ($P = 0.40$ and $P = 0.74$, respectively).

Table 28.--Percentage of 3- and 4-year-old male seals that were recovered on the hauling ground where they were tagged, St. Paul Island, 20 June to 17 July 1969

Date of tagging	Age		Test between age within tagging dates	
	3	4		
	Percent		X^2 square	P
20-23 June	74	80	0.32	0.59
1-5 July	64	75	1.27	0.26
14-17 July	63	81	2.24	0.14
Total			3.83	0.16

Total recoveries were significantly different ($P<0.001$), however, for tags applied on accessible hauling grounds on dissimilar tagging

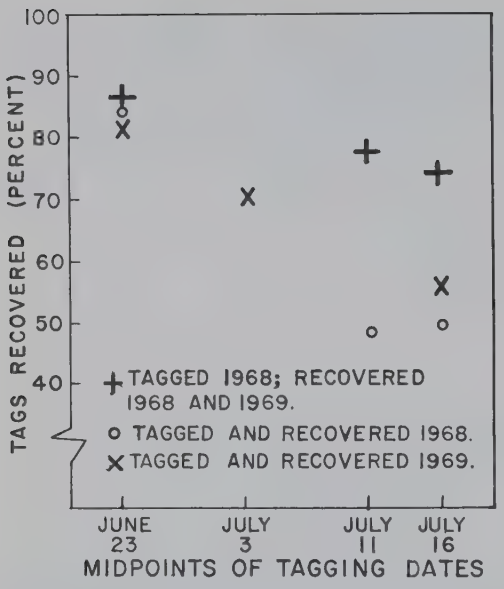


Figure 11.—Percentage recovery of male seals ⩾ 2 years old tagged on accessible hauling grounds, St. Paul Island, June and July 1968-69.

dates (10-11 July 1968 and 1-5 July 1969). Recoveries during a standard recovery interval (11 July to 1 August) were also significantly different ($P<0.01$). Of the seals tagged 10-11 July 1968 and 1-5 July 1969, 43 and 60 percent, respectively, were recovered during the 21 days after tagging. Possible causes for the difference are differences in seasonal behavior or in age compositions of seals tagged during the two periods. Four-year-olds were more abundant among recoveries of seals tagged 1-5 July 1969 than 10-11 July 1968 (table 29). Possibly 4-year-olds spend more time on land than 3-year-olds.

Table 29.--Percentage age composition of male seals ≥2 years old tagged on St. Paul Island, June and July, 1968 and 1969

Date	Age				
Year Day Month	2	3	4	5	6
	Percent				
1968 24-25 June	1	46	52	1	0
1969 20-23 June	2	46	45	6	1
1968 10-11 July	0	73	25	2	0
1969 1-5 July	2	50	43	5	0
1968 18 July	9	82	9	0	0
1969 14-17 July	2	68	29	1	0

Male seals tagged in 1969 and released after capture.—Of 38 male seals ⩾ 2 years old (principally 3- and 4-year-olds) tagged with white-coated tags from 30 June to 17 July 1969, 28 were recaptured once and 8 were recaptured twice. Eleven tagged seals were killed accidentally when first recaptured; 2 were killed in subsequent recaptures. Eight (47 percent) of seventeen seals recaptured previously and not killed were recaptured again. One seal tagged on Zapadni was recaptured there 21 days after tagging and again on Zapadni 4 days later. One seal tagged on Polovina was recaptured on Northeast Point 4 days after tagging and again on Zapadni 4 days later. A seal tagged on Reef was recaptured there 6 days after tagging and again on Zapadni 23 days later. All of the other seals were recaptured on or close to the hauling ground where they were tagged. The average time to the first recapture was 9.4 days and to the second an additional 4.2 days (table 30).

Ten tagged seals were never recaptured. The date of tagging, however, did not influence availability of these seals for recapture. More seals tagged from 30 June to 3 July were taken on the hauling ground of tagging (87 percent) than were seals tagged from 14 to 17 July (46 percent), but the differences were not significant ($P = 0.04$). Some of the seals tagged in 1969 may be recaptured in 1970.

The interval between tagging and the first recapture ranged from 3 to 31 days (average 12.7). The interval between recapture for nine seals caught twice was 3 to 13 days (average 7.2).

Seals from both tagging periods (30 June to 3 July and 14-17 July) strayed, but differences between tagging periods in the numbers that strayed away from the hauling ground where they were tagged were not significant ($P = 0.13$).

Telemetry.—In 1969 we placed radio transmitters on 11 male seals ⩾ 2 years old on St. Paul Island and recovered all but four (table 31). Each seal was also double-tagged on the front flippers with blue-coated (fuse-bond

Table 30. --Recovery of epoxy-coated tags applied to male seals ≥2 years old that were not to be killed, St. Paul Island, 30 June to 17 July 1969

[K = killed]

Tags applied			Tags recovered							
Tag numbers (White X-series)	Hauling ground of tagging[1/]	Date of tagging	Tag number	Hauling ground of first recapture[1/]	Date of recapture	Days to recapture	Hauling ground of second recapture[1/]	Date of recapture	Days to recapture	Tags not recovered
1 and 5-8	NEP(east)	30 June	5	REEF	28 July	28 (K)	---	---	---	
			7	NEP(east)	30 July	30 (K)	---	---	---	
			8	NEP(east)	5 July	5 (K)	---	---	---	
										2
9-13	ZAP	1 July	9	ZAP	7 July	6	---	---	---	
			10	ZAP	22 July	21	NEP(east)	26 July	4	
			11	ZAP	7 July	6 (K)	---	---	---	
			13	ZAP	31 July	30 (K)	---	---	---	
										1
14-18	REEF	2 July	14	REEF	27 July	25 (K)	---	---	---	
			15	REEF	8 July	6	REEF	12 July	4	
			16	TZR	9 July	7	---	---	---	
			17	REEF	8 July	6	ZAP	31 July	23 (K)	
			18	REEF	8 July	6	---	---	---	
										0
21-23	POL	3 July	21	POL	19 July	16	---	---	---	
			22	POL	9 July	6 (K)	---	---	---	
			23	POL	9 July	6	POL	14 July	5	
										0
51-55	POL	14 July	51	ZAP	16 July	2	---	---	---	
			53	NEP(west)	18 July	4	ZAP	22 July	4	
			54	NEP(west)	18 July	4 (K)	---	---	---	
			55	POL	19 July	5	---	---	---	
										1
56-60	NEP(east)	15 July	57	NEP(west)	18 July	3	NEP(west)	25 July	7	
			59	NEP(east)	18 July	3	NEP(east)	25 July	7 (K)	
										3
61-65	ZAP	16 July	61	ZAP	22 July	6	---	---	---	
			62	TZR	19 July	3	ZAP	22 July	3	
			63	ZAP	22 July	6	---	---	---	
			64	ZAP	22 July	6 (K)	---	---	---	
			65	ZAP	22 July	6	---	---	---	
										0
66-70	REEF	17 July	67	POL	23 July	6 (K)	---	---	---	
			69	POL	23 July	6 (K)	---	---	---	
										3
Total			28							10
Mean days out						9.4			4.2	

1/ NEP(east) = east or Morjovi side of Northeast Point; NEP(west) = west or Vostochni side of Northeast Point; TZR = Tolstoi, Zapadni Reef, and Little Zapadni; POL = Polovina and Little Polovina; ZAP = Zapadni; and REEF = Reef, Gorbatch, and Ardiguen.

plastic) cattle-ear tags. Although this experiment was preliminary, the results have not been encouraging to date.

Raymond E. Anas

Weights of Bacula and Testes of Young Male Seals

We collected bacula and testes from male seals ⩾ 2 years old on St. Paul Island from 22 to 26 July 1968. Of 1,300 seals sampled from the kill, body length and age were determined for 1,300 and weights were obtained for the bacula of 944 and paired testes of 60. Figure 12 and table 32 give bacula weights and table 33 gives testes weights.

Raymond E. Anas and Alton Y. Roppel

Body Length and Reproductive Condition of Female Seals Collected on St. Paul Island and at Sea in 1968

This work was carried out to provide information on physiological differences, if any,

Table 31.—Record of radio transmitters and epoxy-coated tags attached to male seals ⩾ 2 years old, St. Paul Island, 1969

Frequency	Tag numbers (Blue X-series)	Attached		Located or recaptured		Remarks
		Hauling ground	Date	Hauling ground	Date	
No radio	607	NEP(east)	20 June	--	--	
30.17	608	NEP(east)	20 June	NEP(east)	15 July	
				NEP(west)	30 July	Killed; had no radio or harness
30.05	609	REEF	20 June	--	--	
30.07	610	POL	20 June	POL	23 June	Lost harness; released with new harness and radio
30.19	610	POL	23 June	POL	9 July	Lost harness; released with no radio
30.17	611	REEF	23 June	REEF	2 July	Killed; no harness
30.18	612	ZAP	23 June	ZAP	26 July	
30.07	613	ARD	24 June	ARD	24-29 June	Radio failed 29 June; radio and harness recovered
30.05	614	NEP(east)	30 June	NEP(east)	2 July	
				NEP(east)	5 July	
30.18	615	ZAP	1 July	ZAP	4 July	
				NEP(east)	25 July	
				NEP(east)	30 July	Killed; had no radio or harness
30.19	616	REEF	2 July	REEF	7 July	
				REEF	8 July	
				REEF	12 July	Killed
30.05	617	NEP(east)	15 July	NEP(east)	19 July	
				POL	24 July	
				POL	29 July	Killed

Table 32.--Weights of bacula, male seals ⩾2 years old, St. Paul Island, 22-26 July 1968

Age	Sample size	Baculum weight		
		Mean	Variance	Range
Years	Number	Dg.		
2	49	6.10	2.468	1/ 3-11
3	592	11.55	15.730	2/ 5-25
4	274	20.89	30.044	9-35
5	24	28.42	65.384	3/ 13-45

1/ Outliers 29 and 49 dg. not included.
2/ Outliers 33 dg. not included.
3/ Outlier 56 dg. not included.

Table 33.--Weights of paired testes, male seals ⩾2 years old, St. Paul Island, 22-26 June 1968

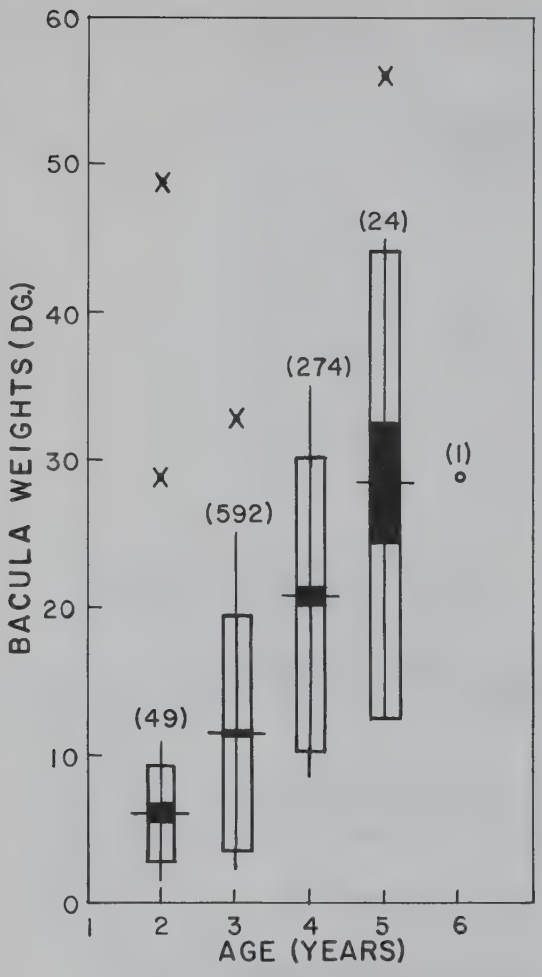
Age	Sample size	Paired testes weight	
		Mean	Range
Years	Number	G.	
2	10	12.30	9.1-18.0
3	20	27.32	13.4-67.4
4	20	56.81	34.8-92.3
5	10	63.56	23.2-99.0

between females hauled out on the Pribilof Islands and those still at sea during comparable times of the year. The data are compared in tables 34, 35, and 36. We could not, however, make any conclusions because the pelagic samples are too small.

Raymond E. Anas, Alton Y. Roppel, and Clifford H. Fiscus.

Body Length of Male Seals, Ages 2 to 5 Years

The minimum body length limit of 42 inches (107 cm.), tip of nose to tip of tail, in effect for several years as a means of permitting small (mostly 2-year-old) seals to escape, was removed for 2 to 8 days in July from 1964 to 1968 and during the entire killing season in 1969. During these periods, all males without



a mane (see glossary) found on the hauling grounds of St. Paul Island were killed, and 20 percent of the animals were sampled for age and body length. These measurements, all of which were taken within the period 17-26 July, should represent an unbiased sample of lengths for all males killed except 5-year-olds. Some 5-year-olds are allowed to escape because they are too large for the market.

We have measured males to determine if their body length varies from year to year and to establish any trends that might exist. We are also studying other relations involving length.

The mean body length by age for seals of most ages increased from 1964 to 1968, then decreased in 1969 (table 37). The increase was most pronounced in 1967 and 1968, and the mean body length varied from year to year, probably in reflection of changes in the environment. We need additional data, however, before we can determine if a trend in length exists or if length is related to population size or survival.

Ancel M. Johnson

Figure 12.—Weights of bacula, male seals $\geq$ 2 years old, St. Paul Island, 22-26 July 1968. Horizontal lines = mean; black vertical bars = mean to $\pm 2S_{\bar{x}}$; open vertical bars = mean $\pm 2S$; vertical lines = range; X = outliers. Numbers in parentheses represent sample sizes.

Table 34.--Mean body lengths[1/] of female seals, St. Paul Island, North Pacific Ocean, [2/] and Bering Sea, by month, 1968

[Numbers in parentheses show sample sizes]

Age	St. Paul Island	North Pacific Ocean				Bering Sea	
	August	May	June	July	August	July	August
Years	Cm.	Cm.				Cm.	
3	108.8 (133)	103.0 (3)	-	103.0 (4)	111.0 (1)	108.2 (5)	109.1 (9)
4	115.2 (419)	110.4 (5)	115.3 (8)	115.8 (4)	-	113.1 (14)	112.6 (19)
5	119.8 (263)	112.8 (4)	112.8 (4)	117.0 (2)	-	117.9 (7)	118.0 (3)

1/ Tip of nose to tip of tail.

2/ Two seals were collected off Southeastern Alaska and 33 were taken in and between the Gulf of Alaska and Unimak Pass.

Table 35. --Percentage of female seals that were pregnant or post partum during the year examined, 1/ by month, St. Paul Island, North Pacific Ocean, 2/ and Bering Sea, 1968

[Numbers in parentheses show sample sizes]

Age	St. Paul Island	North Pacific Ocean				Bering Sea	
	August	May	June	July	August	July	August
Years	Percent	Percent				Percent	
3	2.3	0	-	0	0	0	0
	(133)	(3)	-	(4)	(1)	(5)	(9)
4	9.1	0	25.0	0	-	0	10.5
	(419)	(5)	(8)	(4)	-	(14)	(19)
5	32.7	25.0	50.0	50.0	-	28.6	33.3
	(263)	(4)	(4)	(2)	-	(7)	(3)

1/ Most of the females had or would have given birth to their pups in June or July.

2/ Two seals were collected off Southeastern Alaska and 33 were taken in and between the Gulf of Alaska and Unimak Pass.

Table 36. --Percentage of follicles >5 mm. in diameter in the ovaries of female seals, St. Paul Island, North Pacific Ocean, 1/ and Bering Sea, by month, 1968

[Numbers in parentheses show sample size]

Age	St. Paul Island	North Pacific Ocean				Bering Sea	
	August	May	June	July	August	July	August
Years	Percent	Percent				Percent	
3	31	0	-	50	0	40	11
	(128)	(3)	-	(4)	(1)	(5)	(9)
4	41	20	62	25	-	71	68
	(406)	(5)	(8)	(4)	-	(14)	(19)
5	24	50	25	100	-	57	67
	(249)	(4)	(4)	(2)	-	(7)	(3)

1/ Two seals were collected off Southeastern Alaska and 33 were taken in and between the Gulf of Alaska and Unimak Pass.

Organochlorine Pesticides in Northern Fur Seals, California Sea Lions, and Birds, 1968-69

Tissue samples from several marine mammals and birds were used for this study: fur seals and birds were collected on St. Paul Island in 1968 and 1969, fur seals were taken off the Washington coast in 1969, and sea lions were collected on San Miguel Island, Calif., in 1969. We assumed that all of the animals were healthy. The tissues were frozen immediately, then transported on dry ice to the National Marine Fisheries Service Pesticides Field Station, Gulf Breeze, Fla., where they were analyzed for organochlorine pesticides by Alfred J. Wilson, Jr., Research Chemist.

Pesticides were found in liver and brain samples of 3 of 7 fur seal fetuses and in all of 11 fur seals 1 to 11 years old (table 38). Muscle, brain, liver, blubber, and ingested milk samples from five nursing fur seal pups also contained pesticides (table 39).

Trace amounts of polychlorinated biphenyls (PCB) were found in samples of muscle, liver, and fat from two kittiwakes and one glaucous-winged gull. The muscle, liver, and brain tissues of the gull contained 0.73, 0.13, and 0.41 ppm, respectively, of DDE.

Table 37.—Mean and standard deviations of the body lengths of male seals, St. Paul Island, 17-26 July 1964-69

Age and item	Year measured					
	1964	1965	1966	1967	1968	1969
Age 2:						
Number sampled ..	105	45	146	73	71	120
Mean (cm.)	103.6	105.7	103.8	105.0	107.3	103.8
Standard deviation .	4.93	6.14	4.72	4.29	4.69	5.23
Percent ⩽ 104 cm.[1]	60.9	48.9	55.5	45.2	22.5	59.1
Age 3:						
Number sampled ..	1,233	580	868	502	708	645
Mean (cm.)	112.7	112.8	113.0	115.4	116.3	114.2
Standard deviation .	5.06	5.68	4.91	5.05	5.15	5.02
Percent ⩽ 104 cm.[1]	5.1	6.0	3.1	1.6	1.0	2.6
Age 4:						
Number sampled ..	552	393	336	163	336	278
Mean (cm.)	121.0	122.2	122.5	124.8	125.9	123.7
Standard deviation .	6.48	6.73	6.24	5.95	6.02	5.60
Percent ⩽ 104 cm.[1]	0.5	0.8	0.3	0	0	0
Age 5:						
Number sampled ..	79	29	38	15	28	17
Mean (cm.)	128.0	130.9	131.1	129.8	136.5	130.2
Standard deviation .	7.27	5.02	6.68	5.22	5.55	7.15
Percent ⩽ 104 cm.[1]	0	0	0	0	0	0

[1] The lower length limit of 104 cm. was removed during the sampling period in 1964-68; there was no lower limits during the season in 1969.

Organochlorine pesticides were found in the tissues of all six sea lion pups and in all five female sea lions taken on San Miguel Island (table 40).

Raymond E. Anas

SUMMARY

Field investigations on the Pribilof Islands in 1969 were conducted from June to October with the objective of adding to the fund of knowledge needed to determine the level at which the herd will produce a maximum sustained yield.

A kill of 38,678 males in ages 2 to 6 included 32,621 from St. Paul Island and 6,057 from St. George Island; 230 females were killed accidentally.

In June, we counted 2,341 territorial males with females and 7,935 without; 3 weeks later in mid-July we counted 7,385 territorial males with females and 3,212 without. Total counts of adult males were 10,276 in June and 10,597 in July.

The counts of dead seals on St. Paul and St. George Islands included 14,810 pups of both sexes and 116 males and 170 females older than pups.

The main causes of death among 208 pups were malnutrition (27 percent), hookworm disease (28 percent), and microbial infections (12 percent). Other causes were trauma (6 percent) and perinatal complex (5 percent). Miscellaneous and undetermined causes accounted for 12 percent of the deaths, and 10 percent of the pups were unsuitable for examination.

The average weight of living pups 28-29 August was 9.8 kg. for 400 males and 8.6 kg. for 400 females. These weights were 0.3 kg. more for males and 0.2 kg. more for females than the average of weights of pups about 1 September for 1957-69.

We marked 25,000 pups by removing the tip of a digit on a hind flipper and applied a cryogenic or "freeze" brand to the left forearm of each of 775 pups.

A total of 3,419 males known or believed to be 1 and 2 years old were marked with tags.

Table 38. --Parts per million (mg. /kg.) of pesticides[1/] in liver and brain tissues of northern fur seals

[ND=not detectable; <0.010 ppm.]

Field number	Day Month Year	Age	Pesticide							
			DDE		DDD		DDT		Dieldrin	
		Years	Liver	Brain	Liver	Brain	Liver	Brain	Liver	Brain
Immature males										
US69-76	19-2-69	1	1.90	0.34	0.17	0.03	0.28	0.04	0.02	ND
US69-78	20-2-69	1	0.20	0.06	0.07	ND	0.09	ND	0.02	ND
US69-82	20-2-69	1	5.10	1.70	0.47	0.08	0.38	0.09	0.09	ND
US69-85	20-2-69	1	0.23	0.07	0.05	ND	0.15	ND	ND	ND
US69-117[2/]	25-2-69	3	0.25	0.08	0.09	ND	0.07	ND	ND	ND
R-6683[2/]	2-7-68	3	0.08	0.02	ND	ND	0.03	ND	ND	ND
R-8317[2/]	2-7-68	3	0.08	0.03	ND	ND	0.04	ND	ND	ND
R-9514[2/]	2-7-68	3	0.04	0.02	ND	ND	0.03	ND	ND	ND
Q-17766[2/]	2-7-68	4	0.04	0.02	ND	ND	ND	ND	ND	ND
Q-19800[2/]	2-7-68	4	0.30	0.08	ND	ND	ND	ND	ND	ND
Q-21025[2/]	2-7-68	4	0.07	0.02	ND	ND	0.03	ND	ND	ND
Q-21777[2/]	2-7-68	4	0.06	0.02	ND	ND	ND	ND	ND	ND
Q-24993[2/]	2-7-68	4	0.05	0.02	ND	ND	0.02	ND	ND	ND
Immature and nonpregnant females										
US69-74	19-2-69	1	0.16	0.04	0.06	ND	0.12	ND	ND	ND
US69-75	19-2-69	1	0.15	0.04	ND	ND	ND	ND	ND	ND
US69-81	20-2-69	1	0.32	0.08	0.10	ND	0.27	ND	ND	ND
US69-83	20-2-69	1	0.17	0.07	0.06	ND	0.12	ND	ND	ND
US69-87	21-2-69	1	3.90	1.40	0.41	0.16	0.36	0.17	ND	ND
US69-101	22-2-69	1	0.65	0.17	0.07	ND	0.09	ND	ND	ND
US69-103	25-2-69	1	0.31	0.10	0.16	ND	0.23	ND	ND	ND
US69-118[2/]	25-2-69	6	0.55	0.12	0.13	0.03	0.14	0.03	ND	ND
US69-88[3/]	21-2-69	7	0.89	0.18	0.07	ND	0.10	ND	ND	ND
US69-257[2/]	26-3-69	10	0.15	0.04	0.07	ND	ND	ND	ND	ND
Pregnant females										
US69-45										
Mother	14-2-69	7	0.21	0.07	0.10	0.02	0.07	ND	ND	ND
Fetus[4/]	14-2-69		0.04	ND	ND	ND	ND	ND	ND	ND
US69-77										
Mother	19-2-69	5	0.32	0.06	0.06	ND	0.05	ND	ND	ND
Fetus	19-2-69		0.05	0.03	ND	ND	ND	ND	ND	ND
US69-167[2/]										
Mother	9-3-69	9	0.11	0.05	0.05	ND	ND	ND	ND	ND
Fetus	9-3-69		ND	ND	ND	ND	ND	ND	ND	ND
US69-193[2/]										
Mother	11-3-69	8	0.19	0.05	0.06	ND	0.07	ND	ND	ND
Fetus	11-3-69		ND	ND	ND	ND	ND	ND	ND	ND
US69-200[2/]										
Mother	12-3-69	11	0.23	0.09	0.16	ND	0.11	ND	ND	ND
Fetus	12-3-69		ND	ND	ND	ND	ND	ND	ND	ND
US69-201[2/]										
Mother	12-3-69	6	0.41	0.15	0.11	ND	0.10	ND	ND	ND
Fetus	12-3-69		0.10	0.04	ND	ND	ND	ND	ND	ND
US69-247[2/]										
Mother	24-3-69	10	0.43	0.08	0.20	ND	0.18	ND	ND	ND
Fetus	24-3-69		ND	ND	ND	ND	ND	ND	ND	ND

1/ The insecticide DDT is a mixture of two isomers (o, p'- and p, p'-). The p, p'- compound and its degredation products DDE and DDD are included in this table along with the insecticide dieldrin.

2/ Known-age seals tagged on Pribilof Islands, Alaska.

3/ Known-age seal tagged on Commander Islands, U.S.S.R.

4/ Fetuses were in their 4th month of development.

Table 39. --Pesticides[1/] in tissues and ingested milk of nursing northern fur seal pups, Pribilof Islands, Alaska, 10 November 1969

[ND = not detectable; T = trace]

Tissue and pup number	Residues in ppm. (Mg./kg. wet weight)[2/]				
	DDE	DDD	DDT	Dieldrin	PCB
Muscle					
1	8.1	0.33	0.34	0.038	T
2	0.58	0.060	0.068	ND	T
3	0.19	0.015	0.022	ND	T
4	1.0	0.051	0.084	ND	T
5	0.069	ND	0.019	ND	T
Brain					
1	0.34	ND	0.030	ND	-
2	0.12	ND	ND	ND	-
3	0.18	ND	0.013	ND	-
4	0.058	ND	ND	ND	-
5	0.012	ND	ND	ND	-
Liver					
1	6.4	0.13	0.22	ND	T
2	1.3	0.085	0.11	ND	T
3	1.9	0.14	0.30	ND	T
4	0.22	0.012	0.024	ND	T
5	0.12	0.023	0.057	ND	T
Blubber					
1	45	1.5	1.4	0.089	T
2	11	0.77	0.76	0.042	T
3	14	0.70	0.83	0.046	T
4	2.3	0.29	0.35	0.049	T
5	0.35	0.071	0.22	ND	T
Ingested milk					
1	5.1	0.13	0.20	ND	T
2	4.9	0.12	0.19	0.033	T
3	2.4	0.17	0.20	0.020	T
4	0.32	0.024	0.059	0.020	T
5	0.039	0.017	0.032	0.013	T

1/ See footnote 1, table 38.

2/ Tissues only--residues in milk were calculated on a fat basis.

Of 3,551 marked seals recovered, 2,458 had been given tags or other marks as pups and 1,093 had been given tags at age 1 or older on St. Paul and St. George Islands in previous years. An additional 37 marked seals recovered had been tagged by Soviet biologists on Robben and the Commander Islands.

Tag loss varies with the quality and application of tags, and differences in the ages of seals tagged.

The cattle-ear tag is unsuitable for marking fur seals but data on the relative effectiveness of tags and marks made by removing part of a flipper are inconclusive.

On the basis of recoveries of tagged seals, an estimated 461,000 pups were born on the Pribilof Islands in 1966. Shearing and sampling of pups yielded an estimate of 390,000 for the 1966 year class and 303,500 for the 1969 year class.

The forecasted kill of males on the Pribilof Islands in 1970 includes 4,400 of ages 2 and 5, 34,800 of age 3, and 14,500 of age 4.

The predicted kill of males on the Pribilof Islands in 1969 included 4,200 of ages 2 and 5,

Table 40. --Parts per million (mg./kg.) of pesticides[1/] in tissues of California sea lions

[ND=not detectable; <0.010 ppm.]

Sample number	Age	Pesticide															
		DDE				DDD				DDT				Dieldrin			
		Muscle	Brain	Liver	Blubber	Muscle	Brain	Liver	Blubber	Muscle	Brain	Liver	Blubber	Muscle	Brain	Liver	Blubber
	Years																
Age ≥3 females																	
1	3	5.9	5.1	14.0	416.0	0.13	0.05	0.18	5.1	0.23	0.18	0.60	19.0	ND	ND	ND	0.14
2	19	1.8	2.5	3.5	295.0	0.16	0.10	0.21	18.0	0.11	0.10	0.16	16.0	ND	ND	ND	ND
3	18	0.08	0.25	0.54	15.0	0.01	0.01	0.06	1.4	0.15	0.02	0.09	0.22	ND	ND	ND	ND
4	9	0.12	0.29	0.78	26.0	0.01	0.02	0.07	2.0	0.02	0.03	0.12	3.60	ND	ND	ND	ND
5[2/]	16	12.0	26.0	28.0	884.0	0.72	0.97	1.40	64.0	0.52	0.96	1.20	40.0	ND	0.02	0.02	0.35
Pups[3/]																	
1(♂)[2/]		107.0	13.0	13.0	113.0	4.80	0.42	0.54	52.0	4.70	0.47	0.56	61.0	0.04	ND	ND	0.51
2(♂)		3.4	1.6	4.4	144.0	0.26	0.07	0.28	13.0	0.28	0.10	0.41	16.0	ND	ND	ND	ND
3(♀)[2/]		22.0	6.5	12.0	798.0	1.30	0.32	0.67	57.0	0.76	0.19	0.43	34.0	0.35	0.15	0.03	1.10
4(♂)		22.0	7.2	15.0	840.0	1.40	0.35	1.00	63.0	0.91	0.25	0.65	40.0	ND	ND	ND	ND
5(♀)[2/]		37.0	9.1	14.0	876.0	1.60	0.35	0.99	61.0	1.40	0.33	0.64	43.0	ND	ND	ND	0.17
6(♂)		37.0	3.3	4.7	448.0	2.30	0.13	0.19	21.0	2.40	0.12	0.17	21.0	0.02	ND	ND	0.14

1/ See footnote 1, table 38.

2/ These animals contained detectable amounts of a polychlorinated biphenyl compound.

3/ Pups were approximately 2 months old.

29,500 of age 3, and 22,500 of age 4. Actual kills were 5,200 of ages 2 and 5, 20,471 of age 3, and 12,769 of age 4.

Of 334 2-year-old males tagged on St. Paul Island in 1968, 67.7 percent were recovered in 1968 and 12.8 percent were recovered in 1969; 68.5 percent of 555 males tagged in 1969 were recovered in that year.

In a preliminary experiment in telemetry, 11 radio transmitters were attached to young males on St. Paul Island in 1969. The results were not encouraging.

Weights of the bacula of young males ranged from 3 to 11 dg. at age 2 to 13 to 45 dg. at age 5.

Weights of the testes of young males ranged from 9 to 18 g. at age 2 to 23 to 99 g. at age 5.

The body lengths and reproductive conditions of females collected on St. Paul Island and at sea in 1968 were compared for studies of physiological differences; however, the pelagic sample was too small to permit valid conclusions.

The mean body length of most 2- to 5-year-old males increased from 1964 to 1968 but decreased in 1969.

Organochlorine pesticides were found in the body tissues of fur seals and marine birds collected on St. Paul Island and of sea lions on San Miguel Island, Calif.

ACKNOWLEDGMENTS

The research in 1968 was completed with the cooperation of William L. Peck, Program Director; Roy D. Hurd and Bertel W. Johnson, Management Staff Officers; Richard A. Hajny, Wildlife Management Biologist; Harold A. Thayer, Program Construction Supervisor; Victor Misiken, Village Foreman; Alex Melovidov, Sealer Foreman; and Lee Paola, Superintendent, Oregon-Alaska Marine Products.

GLOSSARY

The following terms used in fur seal research and management on the Pribilof Islands have special meanings or are not readily found in standard dictionaries.

Checkmark A notch, slit, hole, or other mark made on a seal flipper when a tag is applied, to ensure later recognition of an animal that has lost its tag. See mark and lost tag.

Drive The act of surrounding and moving groups of seals on land from one location to another.

Escapement Seals that were not killed because they were too old or too large for the market, or were not available.

Flipper Mark See mark.

Hauling Ground Usually near a rookery, where nonbreeding seals congregate. See rookery.

Haul Out The act of seals moving from the sea to a rookery or hauling ground on shore.

Known-age Refers to a seal whose age is known because the animal bears an inscribed tag or has a certain combination of tag-scar and checkmark.

Lost-tag Refers to a seal known to have been tagged as a pup because it bears a checkmark.

Male Seals, Adult Class 1 Shoreline — Full-grown males about age 10 and older without females but apparently with established territories at the high-tide mark.

Class 2 Territorial without females — Full-grown males about age 10 and older without females but with established territories on the rookery.

Class 3 Territorial with females — Full-grown males about age 10 and older with females and established territories on the rookery.

Class 4 Back fringe — Full-grown and partly grown males about age 7 and older without females and territories that are along the inland fringe of the rookery.

Class 5 Hauling ground — Full-grown and partly grown males about age 7 and older without females that are on traditional hauling grounds.

Mane Long, silver-colored guard hairs on the shoulders and on back of the neck—a secondary sex characteristic of males. The mane appears on some males at age 5, on most at age 6, and on all at age 7.

Mark Examples of marks are a tag, the tip of a digit from a hind flipper removed, a V-notch cut into the leading edge of a front flipper near the tip, or the tip of a front flipper sliced off. When applied to seals in

conjunction with tags, marks made by removing part of a flipper are considered checkmarks.

Rookery Where breeding seals congregate (see hauling ground).

Round The sequence in which hauling grounds on St. Paul Island are visited to harvest seals. When used, a circuit or "round" of the hauling grounds is completed in 5 days, a procedure that is repeated throughout the kill of males. The mean round of the kill is calculated by multiplying the round number by the number killed in that round and dividing the cumulative product by the cumulative kill.

Tagged Refers to a seal with an inscribed metal tag or tags attached to one or more of its flippers.

Tag Recoveries Includes seals that were given tags or other marks, and seals identified from checkmarks as having lost their tags. See checkmark, mark, lost tag, and tagged.

Part II. PELAGIC FUR SEAL INVESTIGATIONS, 1969

Pelagic research provides information useful to us in our management of fur seals that resort to the Pribilof Islands and fulfills United States treaty obligations as stated in the Interim Convention of 1957 and the Protocol of 1963.

We have cooperated with Canada in planning an extensive joint study of fur seals off the Washington and British Columbia coasts and, in 1969, carried out the first of several years of research that we designed for these areas. Canada and the United States have also standardized their methods of collecting and recording information on fur seals and can now exchange data on punch cards.

Our objective is to collect data that will show changes, if any, in the distribution, by age, sex, and time, and to obtain current information on pregnancy rates and food habits of fur seals in the area studied.

Clifford H. Fiscus, Project Leader

RESEARCH IN 1969

We conducted pelagic investigations off Washington from 6 February to 31 March (research cruise No. 32) aboard the M/V *Tonquin*,[6] a chartered vessel.

Equipment and methods used to collect seals at sea have been described by Fiscus, Baines, and Wilke (1964) and by Fiscus and Kajimura (1967). We measured, weighed, and examined the seals we collected in 1969 for checkmarks, tags, scars, general physical condition, barnacles, and algae aboard ships. We also cleaned all canine teeth and preserved the stomachs and reproductive tracts in 10 percent Formalin. In our Seattle laboratory, we sectioned one upper canine tooth from each seal for use in estimating age, and examined the stomach contents and reproductive tracts for studies of food habits and pregnancy rates.

Distribution

Figure 13 shows the distribution of seals in February. Seals were abundant along the continental shelf between Grays Harbor and the mouth of the Columbia River and west of Cape Flattery on the edge of La Perouse Bank. In March (fig. 14), we found concentrations of seals along the continental shelf between Grays Harbor and the mouth of the Columbia River within 55 km. (30 miles) of shore.

Tables B-1 and B-2 give the distribution of seals. Yearlings (1968 year class) were taken closer inshore than older seals.

Abundance

Of 1,136 fur seals sighted, 334 (29.4 percent) were collected, 41 (3.6 percent) were wounded and lost, and 42 (3.7 percent) were killed and lost. The number and relative abundance of seals seen and collected off Washington by 10-day periods are shown in tables B-3 and B-4.

[6] Registered length 29.4 m. (96.6 feet), 200 net tons, 350 horsepower, cruising speed 16.7 km. per hour (9 knots).

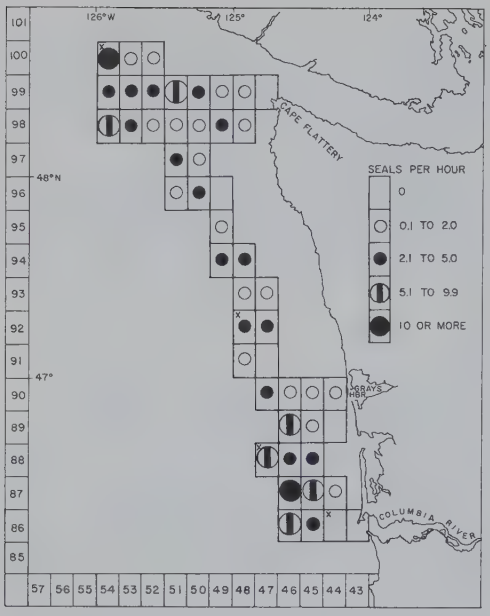


Figure 13.—Number of seals seen per hour of effort in each areal unit occupied by a research vessel in February 1969 off Washington. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-1 for detailed data.

Table B-5 gives the numbers and percentages of animals collected, wounded and lost, and killed and lost among seals sighted, and table B-6 gives these data for seals shot between California and the Bering Sea from 1958 to 1969.

We saw solitary seals more frequently than paired animals or larger groups (table B-7). For example, 38 percent of the animals seen were single and 27 percent were paired; the largest group of seals sighted contained 16 animals; and 32 percent of the animals were in groups of 3 to 7.

Age and Sex

Table 41 gives the age and sex of seals collected in 1969. Fifty-four percent of 299 females killed were 1 to 7 years old, and 48 yearling seals (17 males and 31 females) from the 1968 year class were taken. We appraised the general physical condition of yearling seals by measuring the depth of the subcutaneous layer of fat over the sternum and pelvis (table B-8).

Recoveries of Marked Seals

We killed 26 marked seals (table 42). A 7-year-old female had a tag applied by Soviet biologists on Bering Island in 1962. Three males and twenty-one females had tags attached by U.S. biologists on the Pribilof Islands, who also had removed the tip of the first digit on the right hind flipper of one female that we collected (fig. 9).

Lengths and Weights

Tables B-9 to B-14 give the mean lengths and weights of males and pregnant and non-

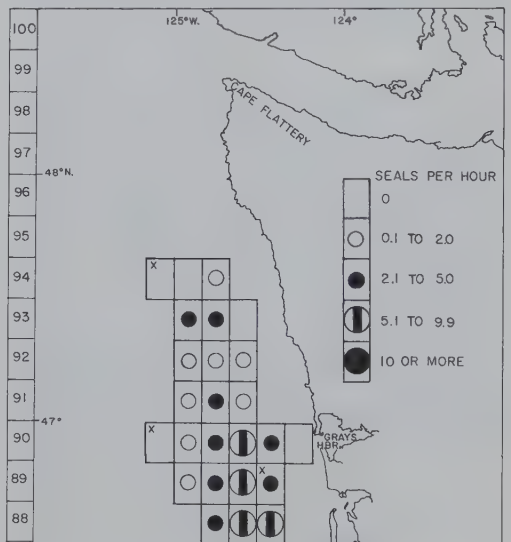


Figure 14.—Number of seals seen per hour of effort in each areal unit occupied by a research vessel in March 1969 off Washington. The sides of each unit measure 10 minutes of latitude by 10 minutes of longitude. Units occupied for less than 0.5 hour are marked "X." See table B-2 for detailed data.

Table 41. --Age and sex, by month, of fur seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	February				March				Total			
	Male		Female		Male		Female		Male		Female	
Years	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
1	7	53.8	11	10.1	10	45.5	20	10.5	17	48.6	31	10.4
2	4	30.8	-	-	5	22.7	6	3.2	9	25.7	6	2.0
3	1	7.7	5	4.6	4	18.2	14	7.4	5	14.3	19	6.4
4	1	7.7	10	9.2	3	13.6	22	11.6	4	11.4	32	10.7
5	-	-	7	6.4	-	-	16	8.4	-	-	23	7.7
6	-	-	8	7.3	-	-	15	7.9	-	-	23	7.7
7	-	-	11	10.1	-	-	16	8.4	-	-	27	9.0
8	-	-	10	9.2	-	-	12	6.3	-	-	22	7.4
9	-	-	1	0.9	-	-	4	2.1	-	-	5	1.7
10	-	-	9	8.2	-	-	12	6.3	-	-	21	7.0
11	-	-	13	11.9	-	-	13	6.8	-	-	26	8.7
12	-	-	7	6.4	-	-	17	8.9	-	-	24	8.0
13	-	-	4	3.7	-	-	7	3.7	--	-	11	3.7
14	-	-	3	2.8	-	-	4	2.1	-	-	7	2.3
15	-	-	1	0.9	-	-	3	1.6	-	-	4	1.3
16	-	-	1	0.9	-	-	4	2.1	-	-	5	1.7
17	-	-	5	4.6	-	-	2	1.1	-	-	7	2.3
18	-	-	3	2.8	-	-	1	0.5	-	-	4	1.3
19	-	-	-	-	-	-	2	1.1	-	-	2	0.7
Total	13		109		22		190		35		299	

pregnant females collected in 1969. These data are also shown for male and female fetuses, by 10-day periods, in table B-15.

Table 42. --Tag recoveries from fur seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

[Figures in parentheses indicate number of animals that had lost tags; they are included in the totals]

Age	Year of tagging	Tag series	Seals tagged or marked	Tag recovery		Seals collected in each age group 1/	
				♂	♀	♂	♀
Years			Number	---Number--		---Number----	
1	1968	U	11,675	2	2	17	31
3	1966	S	24,580	1	-	5	19
4	1965	R	30,087	-	2/2	4	32
6	1963	P	24,971	-	4(1)	-	23
7	1962	O	49,908	-	3/4(1)	-	27
8	1961	N	49,921	-	4(1)	-	22
9	1960	M	59,981	-	1	-	5
10	1959	L	49,881	-	2	-	21
11	1958	K	49,917	-	2(1)	-	26
12	1957	J	49,842	-	2(1)	-	24

1/ Table does not include seals born in years when seals were not tagged, nor year classes from which no tagged seals were taken.

2/ Seal was marked only and is included in tagged seal total.

3/ Includes one 7-year-old seal tagged by U.S.S.R. (K17884).

Reproduction

The youngest pregnant female collected was a 4-year-old primiparous seal taken in March. Six primiparous and two multiparous and pregnant 5-year-old females were the next youngest, and the oldest pregnant seal was 19. The 4-year-old and the two multiparous 5-year-old females had conceived at age 3 and gave or would have given birth to their first pup at age 4. We took three 6-year-old nonpregnant, multiparous females that had aborted—two in February and one in March.

Table B-16 shows the reproductive condition, by month, of female seals taken in 1969, and table B-17 gives the pregnancy rates of females age 3 and older. The pregnancy rates of all female seals collected in the eastern North Pacific Ocean by the United States since 1958 are shown in table 43.

Most mature females ovulate each year. Missed pregnancies occur when the egg is not fertilized or, if fertilized, fails to implant. Resorbing corpora lutea indicated that 48 percent of the nonpregnant seals ages 4 to 19 years had missed pregnancies (table B-18)

Table 43.--Number of female seals collected pelagically by the United States in the eastern Pacific Ocean and (in parentheses) percentage pregnant, 1958-69

Age Years	Year												1958-69 combined
	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	
	Number												
3	39 (2.6)	43 (0.0)	18 (0.0)	84 (0.0)	93 (1.1)	53 (0.0)	74 (0.0)	51 (0.0)	30 (0.0)	10 (0.0)	35 (0.0)	19 (0.0)	549 (0.4)
4	42 (2.4)	93 (6.4)	36 (2.8)	96 (1.0)	140 (2.9)	113 (7.1)	62 (1.6)	73 (0.0)	68 (1.5)	9 (0.0)	95 (5.3)	32 (3.1)	859 (3.4)
5	70 (45.7)	114 (56.1)	55 (49.1)	68 (20.6)	123 (26.0)	162 (43.8)	84 (35.7)	23 (26.1)	66 (27.3)	9 (44.4)	37 (37.8)	23 (34.8)	834 (38.4)
6	99 (80.8)	118 (77.1)	45 (80.0)	62 (75.8)	72 (54.2)	90 (74.4)	81 (75.3)	37 (56.8)	35 (71.4)	20 (60.0)	47 (76.6)	23 (56.5)	729 (72.4)
7	103 (89.3)	143 (76.2)	66 (78.8)	95 (75.8)	93 (84.9)	77 (88.3)	44 (77.3)	24 (79.2)	46 (78.3)	7 (71.4)	69 (72.5)	27 (63.0)	794 (79.7)
8	102 (89.2)	164 (86.6)	105 (85.7)	107 (79.4)	98 (89.8)	87 (97.7)	46 (84.8)	33 (84.8)	43 (79.1)	7 (85.7)	38 (78.9)	22 (72.7)	852 (86.2)
9	81 (96.3)	108 (88.9)	144 (92.4)	114 (93.9)	73 (83.6)	60 (85.0)	30 (83.3)	17 (70.6)	20 (100.0)	12 (100.0)	40 (82.5)	5 (100.0)	704 (89.9)
10	97 (87.6)	96 (85.4)	129 (91.5)	112 (93.8)	100 (89.0)	72 (93.1)	49 (87.8)	10 (90.0)	13 (84.6)	11 (90.9)	40 (77.5)	21 (81.0)	750 (88.9)
11	113 (92.0)	98 (89.8)	136 (91.2)	82 (89.0)	91 (89.0)	88 (94.3)	42 (85.7)	18 (83.3)	23 (78.3)	4 (100.0)	39 (76.9)	26 (73.1)	760 (88.8)
12	134 (82.0)	76 (88.2)	106 (90.6)	71 (93.0)	97 (89.7)	92 (92.4)	51 (84.3)	15 (73.3)	16 (100.0)	3 (66.7)	40 (90.0)	24 (83.3)	725 (88.1)
13	110 (82.7)	56 (89.3)	120 (87.5)	76 (82.9)	58 (94.8)	76 (90.8)	33 (84.8)	8 (100.0)	12 (100.0)	3 (100.0)	24 (83.3)	11 (36.4)	587 (86.5)
14	92 (81.5)	70 (84.3)	107 (80.4)	67 (92.5)	65 (87.7)	57 (80.7)	38 (76.3)	10 (80.0)	14 (85.7)	1 (100.0)	26 (80.8)	7 (71.4)	554 (83.2)
15	71 (78.9)	87 (88.5)	67 (83.6)	68 (79.4)	53 (81.1)	75 (85.3)	41 (65.9)	14 (78.6)	15 (93.3)	3 (66.7)	30 (86.7)	4 (100.0)	528 (82.2)
16	56 (78.6)	69 (75.4)	53 (71.7)	55 (85.5)	50 (82.0)	45 (82.2)	22 (72.7)	12 (83.3)	5 (80.0)	6 (100.0)	26 (96.2)	5 (60.0)	404 (80.0)
17	36 (56.6)	36 (80.6)	46 (67.4)	24 (62.5)	44 (72.7)	28 (71.4)	21 (61.9)	10 (80.0)	5 (40.0)	2 (0.0)	21 (81.0)	7 (57.1)	280 (68.2)
18	22 (59.1)	27 (85.2)	23 (82.6)	25 (64.0)	25 (72.0)	12 (58.3)	20 (60.0)	8 (37.5)	- -	- -	11 (72.7)	4 (75.0)	177 (68.9)
19	14 (28.6)	16 (81.3)	19 (57.9)	10 (50.0)	15 (60.0)	5 (60.0)	7 (57.1)	2 (0.0)	3 (33.3)	- -	10 (60.0)	2 (50.0)	103 (55.3)
20	3 (33.3)	5 (40.0)	6 (16.7)	7 (100.0)	11 (72.7)	11 (45.5)	10 (20.0)	2 (0.0)	1 (0.0)	1 (0.0)	7 (71.4)	- -	64 (48.4)
21	1 (100.0)	7 (85.7)	6 (50.0)	2 (50.0)	3 (100.0)	4 (50.0)	- -	1 (0.0)	1 (0.0)	- -	3 (33.3)	- -	28 (60.7)
22	1 (0.0)	5 (40.0)	- -	- -	3 (66.7)	- -	- -	- -	- -	1 (0.0)	3 (0.0)	- -	13 (30.8)
23	- -	1 (0.0)	1 (0.0)	1 (0.0)	- -	2 (0.0)	1 (100.0)	1 (0.0)	- -	- -	1 (0.0)	- -	8 (12.5)
24	- -	1 (0.0)	1 (0.0)	1 (0.0)	1 (0.0)	- -	- -	- -	- -	- -	- -	- -	4 (0.0)
26	- -	1 (0.0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (0.0)
Total	1,286 (76.1)	1,434 (73.8)	1,289 (79.7)	1,227 (68.5)	1,308 (63.4)	1,209 (69.3)	756 (58.7)	369 (45.8)	416 (52.3)	109 (61.5)	642 (61.4)	262 (53.4)	10,307 (68.0)
6-26 years	1,135 (83.3)	1,184 (83.4)	1,180 (84.4)	979 (84.3)	952 (83.2)	881 (86.0)	536 (77.0)	222 (73.4)	252 (81.3)	81 (77.8)	475 (78.9)	188 (69.7)	8,065 (82.6)

Uterine Horn of Conception and Fetal Sex Ratio

In the fur seal the first conception seems to occur randomly in either side of the bicornuate uterus, then alternately between horns thereafter. For example, 51 percent of 5,868 pregnant and post-parturient females taken since 1958 had conceived in the left uterine horn and 49 percent in the right. Forty-eight percent of 140 pregnant seals taken in 1969 had conceived in the left uterine horn. In addition, 47 percent of the left and 53 percent of the right uterine horns of 19 primiparous females had fetuses.

The fetal sex ratio in fur seals is about equal. In 1969, 55 percent of 140 fetuses were males and 45 percent were females. Since 1958 we have examined 5,117 fetuses, of which 49 percent were males and 51 percent were females.

Feeding Habits

Research on the feeding habits of fur seals since 1958 has shown that these animals consume a wide variety of fish and cephalopods throughout their range in the eastern North Pacific Ocean and eastern Bering Sea. Fur seals feed mainly from dusk to dawn on readily available food, mostly fishes and squids near the surface.

Of 333 seal stomachs collected in 1969, 190 (57 percent) contained food (table 44). Most (92.3 percent) of the total food volume was contributed by four species or groups: northern anchovy, *Engraulis mordax*; rockfish, *Sebastodes* spp.; capelin, *Mallotus villosus;* and

Table 44. --Stomach contents of fur seals collected pelagically by the United States off Washington, 6 February to 29 March 1969 1/

Food	Winter February Volume Cc.	Winter February Volume Percent	Winter February Frequency Number	Spring March Volume Cc.	Spring March Volume Percent	Spring March Frequency Number	February-March Volume Cc.	February-March Volume Percent	February-March Frequency Number
Fish									
Lampetra tridentata	15	0.0	2	15	0.0	1	30	0.0	3
Clupeidae	-	-	-	T	-	2	T	-	2
Alosa sapidissima	971	3.7	3	45	0.2	1	1,016	1.9	4
Clupea harengus pallasi	1,484	5.6	10	215	0.8	6	1,699	3.2	16
Engraulis mordax	7,288	27.5	19	9,996	38.0	29	17,284	32.7	48
Salmonidae	50	0.2	2	5,903	22.4	14	5,953	11.3	16
Osmeridae	-	-	-	39	0.1	4	39	0.1	4
Mallotus villosus	5,834	22.0	15	4,408	16.8	16	10,242	19.4	31
Thaleichthys pacificus	343	1.3	3	454	1.7	2	797	1.5	5
Merluccius productus	50	0.2	1	11	0.0	1	61	0.1	2
Gasterosteus aculeatus	105	0.4	2	-	-	-	105	0.2	2
Sebastodes spp.	10,101	38.2	12	5,124	19.5	6	15,225	28.9	18
Pleuronectidae	74	0.3	1	-	-	-	74	0.1	1
Unidentified	20	0.1	17	16	0.1	38	36	0.1	55
Squid									
Loligo opalescens	57	0.2	15	T	-	3	57	0.1	18
Onychoteuthis sp.	86	0.3	6	107	0.4	12	193	0.4	18
Abraliopsis sp.	7	0.0	1	-	-	-	7	0.0	1
Gonatidae	T	-	6	T	-	7	T	-	13
Gonatus spp.	T	-	8	10	0.0	6	10	0.0	14
Unidentified	T	-	2	-	-	-	T	-	2
Bird	T	-	2	-	-	-	T	-	2
Isopoda	T	-	1	-	-	-	T	-	1
Crustacea	T	-	2	-	-	-	T	-	2
Total	26,485			26,343			52,828		
Stomachs with food	190								
Stomachs empty	143								
Stomachs missing	1								

1/ T=trace (<5 cc.). Trace counts are included in frequency counts.

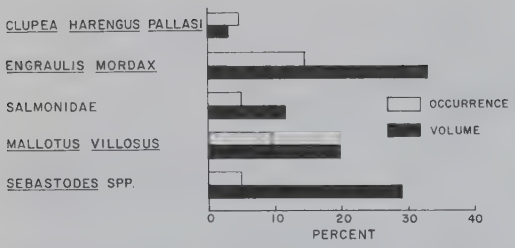


Figure 15.—Percentage of stomach content volume and percentage occurrence of principal food species in fur seal stomachs collected off Washington in 1969.

salmonids (fig. 15). Anchovy, the leading food species with 32.7 percent of the total volume, was followed in importance by rockfish and capelin. Salmonids (16 occurrences), the fourth leading food species, contributed 11.3 percent of the total volume. Two species of Pacific salmon (coho, *Oncorhynchus kisutch*, and chinook, *O. tshawytscha*) were identified from their scales. The coho salmon had spent 1 year and the chinook salmon 1 or 2 years in the ocean.[7]

The locations of principal food species off Washington in February and March 1969, as indicated by the contents of seal stomachs during this period, are shown in figures 16 to 20.

Relation of Food of Fur Seals to Commercial Fisheries

According to our studies, several species of commercially valuable fish have been eaten by fur seals since 1958, and salmon, *Oncorhynchus* spp., were the most valuable fish taken by this animal off Washington (16 occurrences) in 1969.

The effect of fur seals on commercially important fishes cannot be accurately assessed with our limited knowledge of the ocean environment and its ecology.

Clifford H. Fiscus and
Hiroshi Kajimura

[7] Species and time spent in the ocean were determined by Julaine Lyons and Kenneth H. Mosher, National Marine Fisheries Service, Biological Laboratory, Seattle, Wash.

SUMMARY

Pelagic investigations in 1969 were conducted in February and March in the eastern North Pacific Ocean off the State of Washington. The objective was to collect data that would show changes, if any, in the distribution of fur seals by sex, age, and time, and to obtain current information on pregnancy rates and food habits.

Of 1,136 fur seals sighted, 334 were collected, 41 were wounded and lost, and 42 were killed and lost.

Solitary seals were more prevalent than paired or large groups of animals.

Fifty-four percent of 299 females killed were from 1 to 7 years old, and 48 yearling seals (17 males and 31 females) from the 1968 year class were taken.

Of 26 marked seals recovered, 1 female had been tagged on Bering Island, and 3 males and 21 females had been tagged and 1 female had had the tip of the first digit on her right hind flipper removed on the Pribilof Islands.

A primiparous 4-year-old was the youngest and a multiparous 19-year-old the oldest among pregnant females taken; 55 percent of 140 fetuses were males and 45 percent were females. Forty-eight percent of the nonpregnant seals 4 to 19 years of age had ovulated.

Pregnancy rates among females age 5 and older collected off Washington in February and March since 1958 have ranged from 38 to 90 percent.

Of 333 seal stomachs, 190 contained food. Anchovy, the leading food species, was followed in importance by rockfish, capelin, and salmonids.

Salmon were the most valuable of the commercial fishes eaten by fur seals off Washington in 1969.

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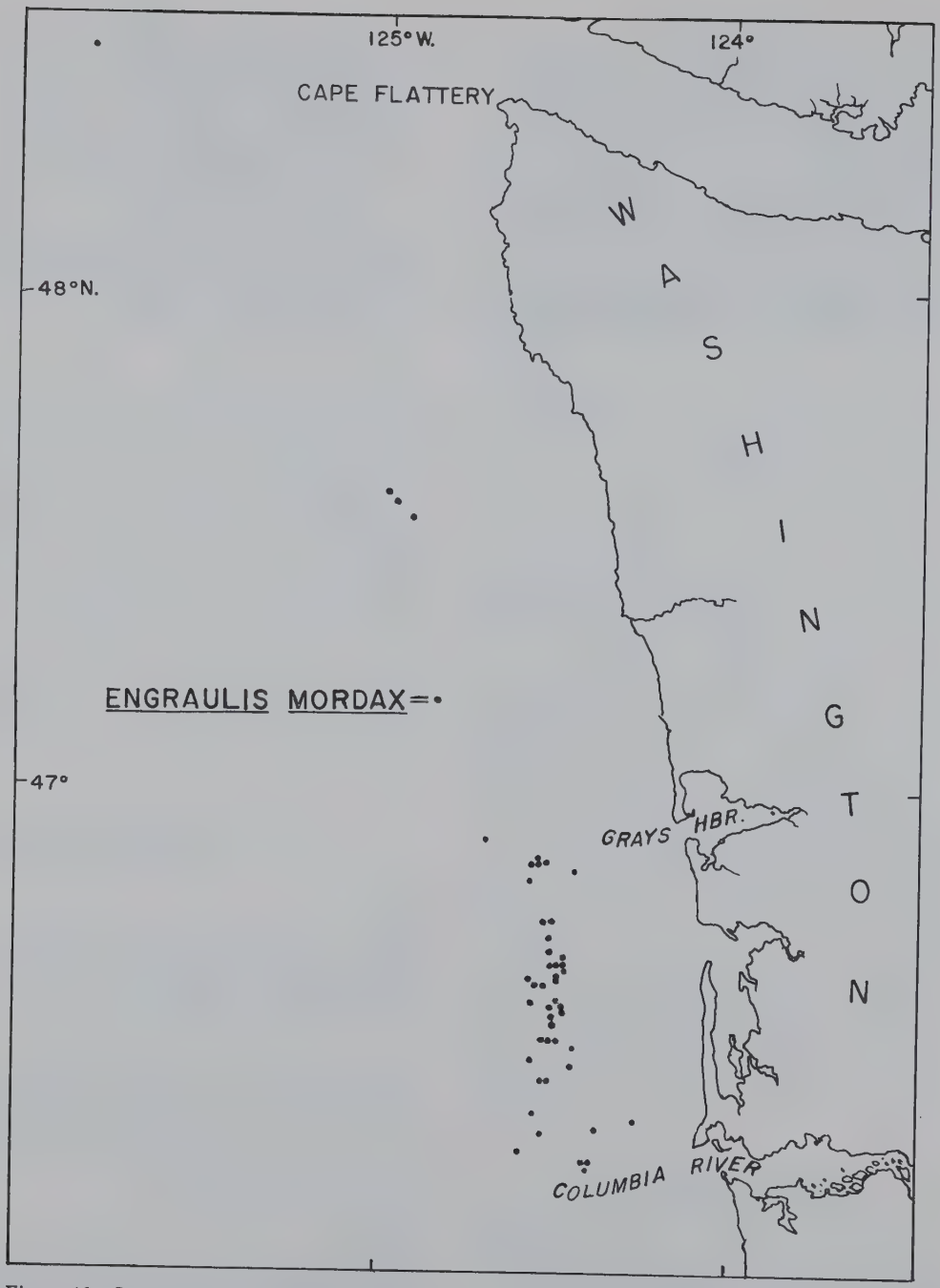

Figure 16.—Locations where fur seal stomachs collected off Washington in 1969 contained *Engraulis mordax* (48 occurrences).

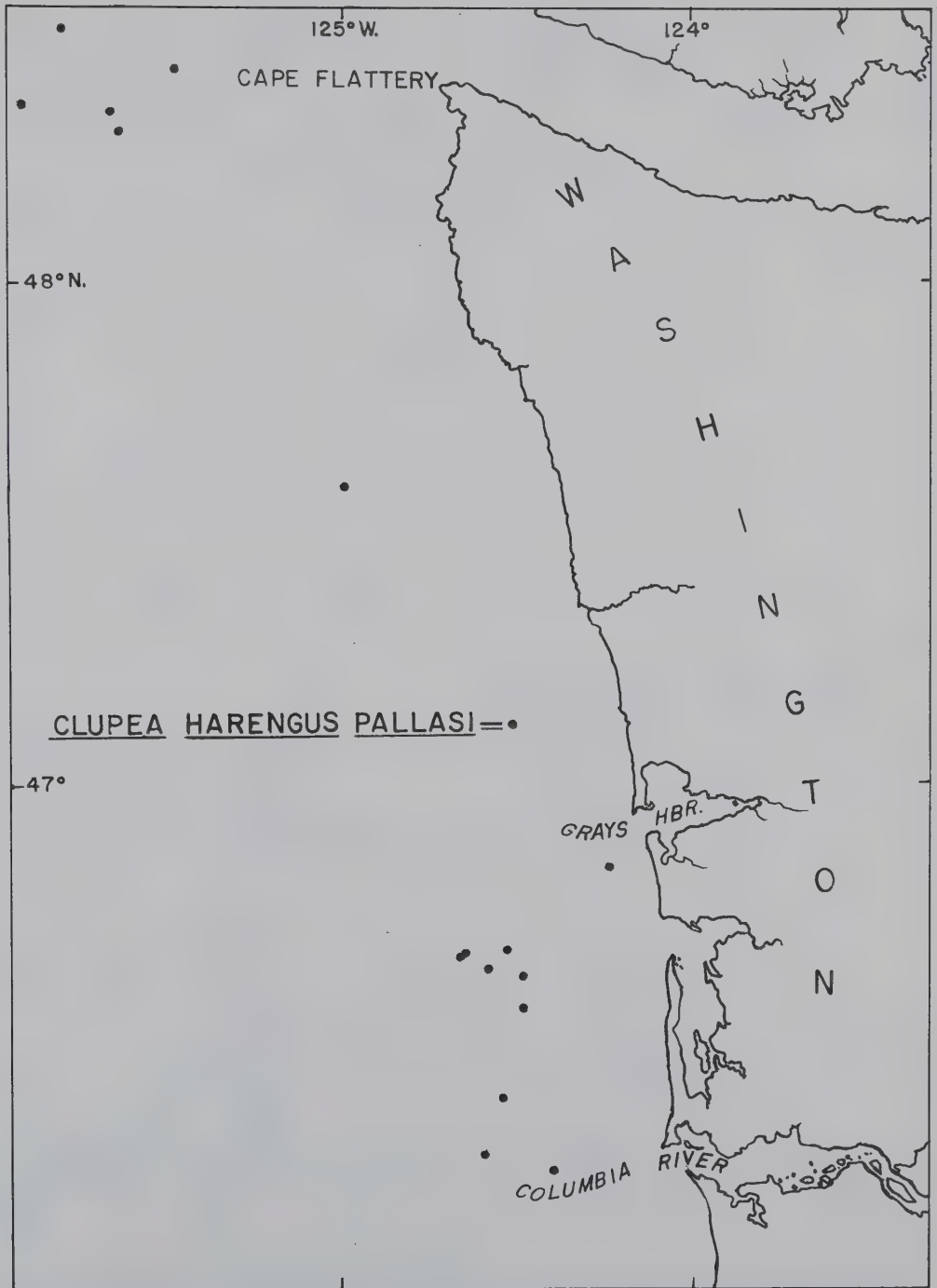

Figure 17.—Locations where fur seal stomachs collected off Washington in 1969 contained *Clupea harengus pallasi* (16 occurrences).

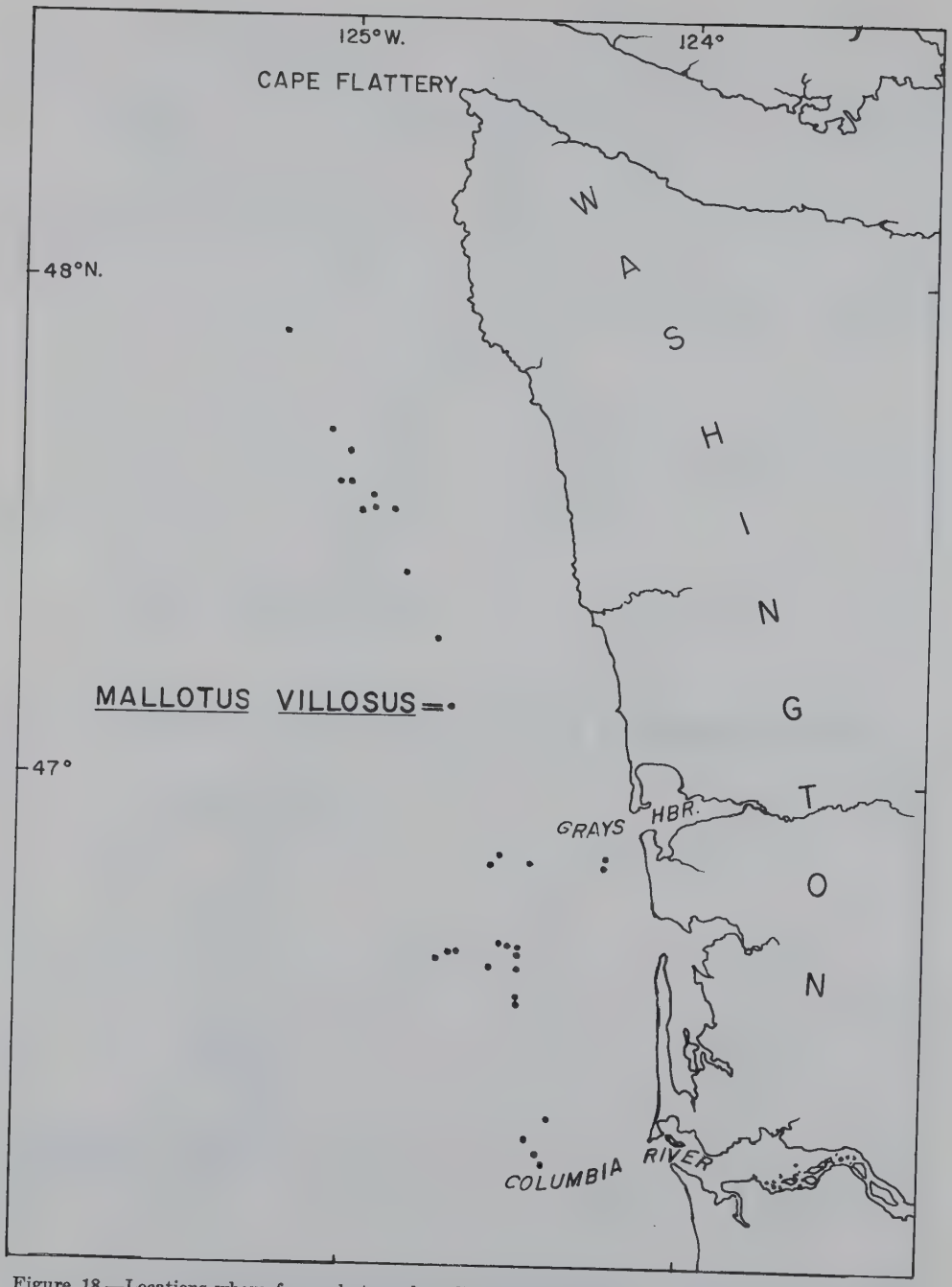

Figure 18.—Locations where fur seal stomachs collected off Washington in 1969 contained *Mallotus villosus* (31 occurrences).

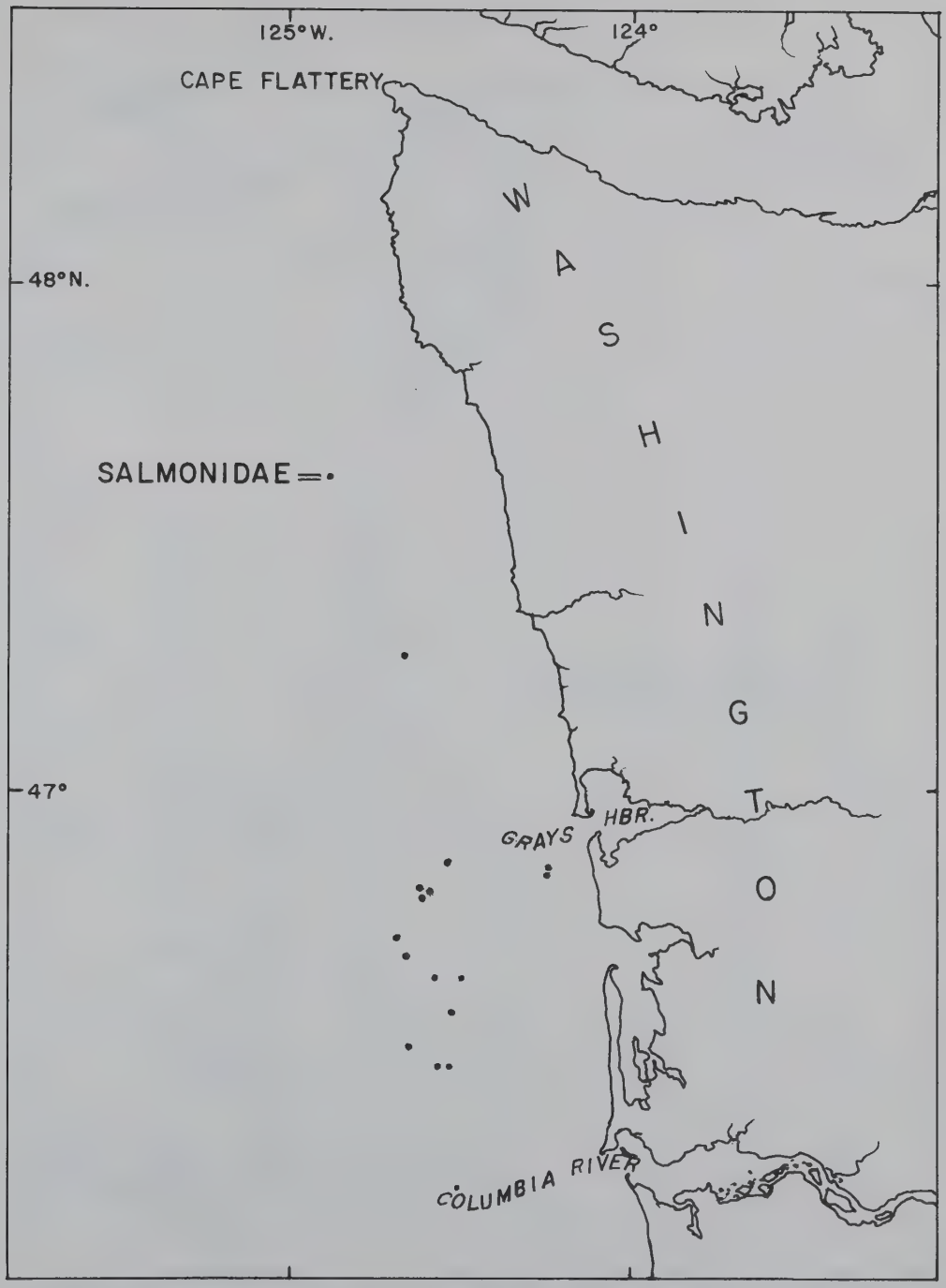

Figure 19.—Locations where fur seal stomachs collected off Washington in 1969 contained Salmonidae (16 occurrences).

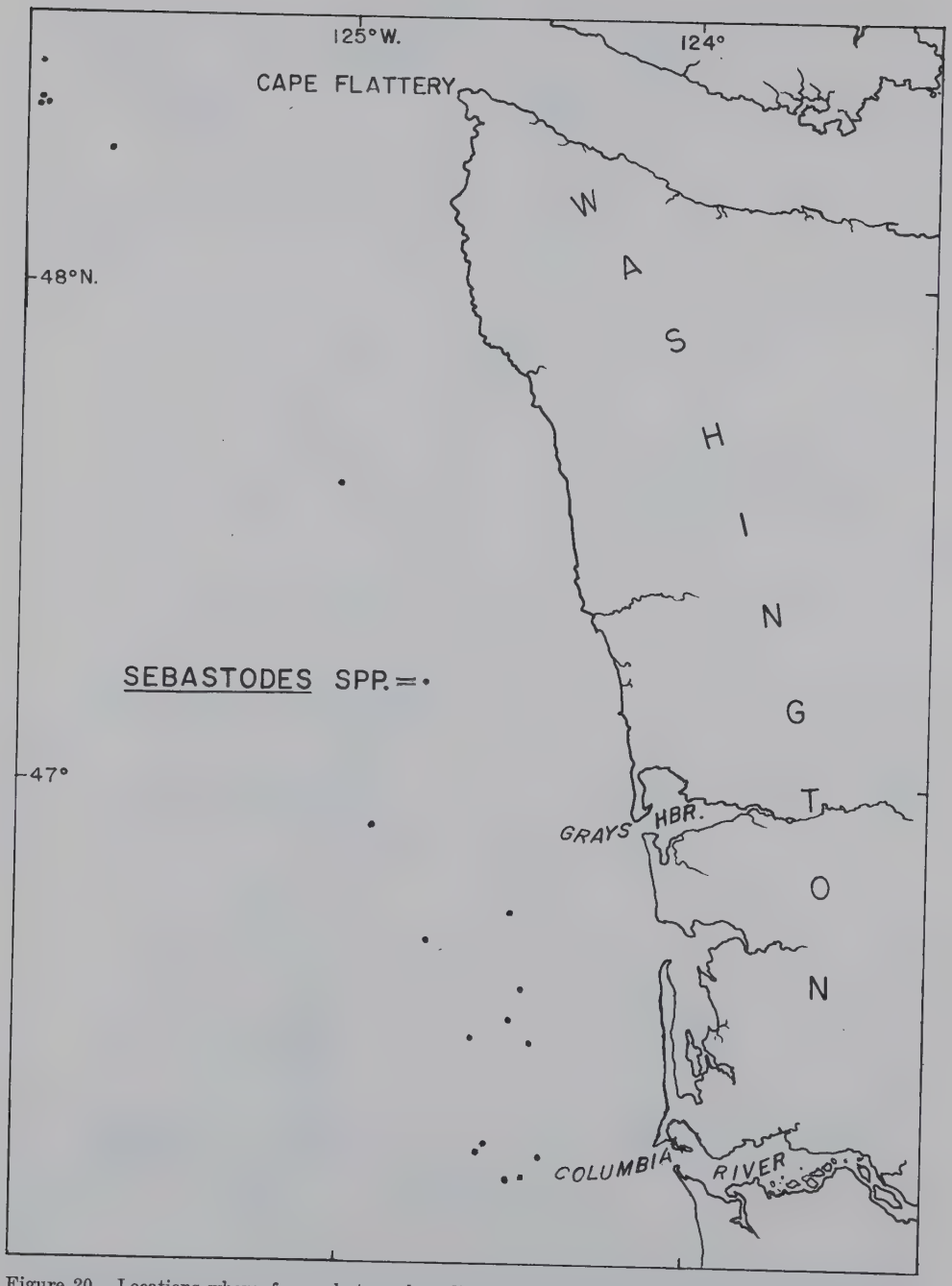

Figure 20.—Locations where fur seal stomachs collected off Washington in 1969 contained *Sebastodes* spp. (18 occurrences).

APPENDIX A

Table A-1.--Age classification of male seals killed on St. Paul Island, 25 June to 1 August 1969

Date	Rookery[1/]	Males killed	Tooth sample	Seals in each age group of sample					Estimated seals killed from each age group				
				2	3	4	5	6	2	3	4	5	6
		Number	Number	Percent					Number				
June													
25	NEP(east)	434	91	2.2	25.3	48.3	20.9	3.3	10	110	210	90	14
25	NEP(west)	229	42	2.4	14.3	33.3	40.5	9.5	5	33	76	93	22
26	ZAP	520	93	-	35.5	45.2	16.1	3.2	-	184	235	84	17
27	REEF	804	142	0.7	33.1	43.7	19.7	2.8	6	267	351	158	22
28	L-K	101	21	-	9.5	57.1	33.4	-	-	9	58	34	-
28	POL	307	58	-	27.6	48.3	24.1	-	-	85	148	74	-
28	TZR	157	28	-	25.0	57.1	17.9	-	-	39	90	28	-
30	NEP(east)	428	87	1.2	35.6	47.1	14.9	1.2	5	152	202	64	5
30	NEP(west)	185	37	2.7	13.5	59.5	24.3	-	5	25	110	45	-
July													
1	ZAP	216	41	-	36.6	51.2	12.2	-	-	79	111	26	-
2	L-K	55	11	-	36.4	45.4	18.2	-	-	20	25	10	-
2	REEF	318	63	1.6	30.1	52.4	11.1	4.8	5	96	167	35	15
3	POL	123	22	-	27.3	54.5	18.2	-	-	34	67	22	-
3	TZR	835	162	1.9	48.8	43.2	4.9	1.2	16	407	361	41	10
5	NEP(east)	819	154	3.9	33.1	51.3	11.0	0.7	32	271	420	90	6
7	NEP(west)	268	49	2.0	44.9	49.0	4.1	-	5	121	131	11	-
7	ZAP	944	188	2.6	54.8	39.4	3.2	-	25	517	372	30	-
8	REEF	937	185	4.9	54.6	38.4	2.1	-	46	511	360	20	-
9	TZR	418	83	3.6	54.2	39.8	2.4	-	15	227	166	10	-
9	POL	505	87	3.5	40.2	51.7	4.6	-	18	203	261	23	-
9	L-K	171	32	-	59.4	40.6	-	-	-	102	69	-	-
10	NEP(east)	595	118	1.7	50.0	44.9	3.4	-	10	298	267	20	-
11	ZAP	623	116	1.7	56.0	39.7	2.6	-	11	349	247	16	-
12	REEF	796	159	3.1	60.4	34.6	1.9	-	25	481	275	15	-
14	POL	187	36	-	44.4	55.6	-	-	-	83	104	-	-
14	TZR	851	167	3.0	60.5	32.3	4.2	-	25	515	275	36	-
15	NEP(east)	431	133	3.8	64.6	30.1	1.5	-	16	278	130	7	-
15	NEP(west)	529	45	4.4	66.7	28.9	-	-	23	353	153	-	-
16	ZAP	1,355	260	5.0	61.2	31.9	1.9	-	68	829	432	26	-
17	REEF	801	145	10.3	63.5	23.5	2.7	-	82	509	188	22	-
17	L-K	193	31	3.2	38.7	51.6	6.5	-	6	75	99	13	-
18	NEP(east)	987	195	9.8	60.5	28.7	1.0	-	97	597	283	10	-
18	NEP(west)	346	66	7.6	59.1	24.2	7.6	1.5	26	205	84	26	5
19	POL	288	45	6.7	26.6	57.8	8.9	-	19	77	166	26	-
19	TZR	503	94	-	58.5	35.1	6.4	-	-	294	177	32	-
22	ZAP	1,789	347	10.3	64.3	24.2	1.2	-	184	1,150	433	22	-
23	REEF	1,199	237	12.2	55.7	29.2	2.5	0.4	146	668	350	30	5
23	L-K	307	61	13.1	70.5	14.8	1.6	-	40	216	46	5	-
24	TZR	221	43	2.3	60.5	34.9	2.3	-	5	134	77	5	-
24	POL	404	120	9.2	60.8	28.3	1.7	-	37	246	114	7	-
25	NEP(east)	1,140	224	12.1	60.7	26.3	0.9	-	138	692	300	10	-
25	NEP(west)	409	73	12.3	53.5	31.5	2.7	-	50	219	129	11	-
26	ZAP	1,359	239	11.7	59.8	26.8	1.7	-	159	813	364	23	-
28	REEF	1,601	304	18.4	62.2	18.1	1.3	-	294	996	290	21	-
29	POL	1,438	255	9.0	57.2	31.0	2.8	-	129	823	446	40	-
29	TZR	316	59	3.4	47.5	49.1	-	-	11	150	155	-	-
29	L-K	270	50	22.0	60.0	18.0	-	-	59	162	49	-	-
30	NEP(east)	874	173	11.6	69.9	17.3	1.2	-	101	612	151	10	-
30	NEP(west)	166	35	14.3	60.0	25.7	-	-	24	99	43	-	-
30	TZR	563	97	9.3	74.2	16.5	-	-	52	418	93	-	-
31	ZAP	1,816	338	13.3	60.6	25.1	0.9	-	242	1,101	457	16	-
Aug.													
1	REEF	1,028	158	29.1	58.2	10.1	2.6	-	299	598	104	27	-
1	L-K	462	88	14.8	63.6	20.5	1.1	-	69	294	94	5	-
Season total		32,621	6,187						2,640	17,826	10,565	1,469	121

1/ NEP(east)=east or Morjovi side of Northeast Point; NEP(west)=west or Vostochni side of Northeast Point; TZR=Tolstoi, Zapadni Reef, and Little Zapadni; POL=Polovina and Little Polovina; ZAP Zapadni; REEF=Reef, Gorbatch, and Ardiguen; L-K=Lukanin and Kitovi.

Table A-2. --Cumulative age classification of male seals killed on St. Paul Island, 25 June to 1 August 1969

Date	Rookery[1/]	Estimated seals killed from each age group					Total kill	Seals killed from each age group				
		2	3	4	5	6		2	3	4	5	6
		Number						Percent				
June												
25	NEP(east)	10	110	210	90	14	434	2	25	49	21	3
25	NEP(west)	15	143	286	183	36	663	2	22	43	28	5
26	ZAP	15	327	521	267	53	1,183	1	28	44	23	4
27	REEF	21	594	872	425	75	1,987	1	30	44	21	4
28	L-K	21	603	930	459	75	2,088	1	29	45	22	3
28	POL	21	688	1,078	533	75	2,395	1	29	45	22	3
28	TZR	21	727	1,168	561	75	2,552	1	28	46	22	3
30	NEP(east)	26	879	1,370	625	80	2,980	1	29	46	21	3
30	NEP(west)	31	904	1,480	670	80	3,165	1	29	47	21	2
July												
1	ZAP	31	983	1,591	696	80	3,381	1	29	47	21	2
2	L-K	31	1,003	1,616	706	80	3,436	1	29	47	21	2
2	REEF	36	1,099	1,783	741	95	3,754	1	29	48	20	2
3	POL	36	1,133	1,850	763	95	3,877	1	29	48	20	2
3	TZR	52	1,540	2,211	804	105	4,712	1	33	47	17	2
5	NEP(east)	84	1,811	2,631	894	111	5,531	1	33	48	15	2
7	NEP(west)	89	1,932	2,762	905	111	5,799	1	33	48	16	2
7	ZAP	114	2,449	3,134	935	111	6,743	2	36	46	14	2
8	REEF	160	2,960	3,494	955	111	7,680	2	39	46	12	1
9	TZR	175	3,187	3,660	965	111	8,098	2	39	46	12	1
9	POL	193	3,390	3,921	988	111	8,603	2	39	46	12	1
9	L-K	193	3,492	3,990	988	111	8,774	2	40	46	11	1
10	NEP(east)	203	3,790	4,257	1,008	111	9,369	2	40	46	11	1
11	ZAP	214	4,139	4,504	1,024	111	9,992	2	42	45	10	1
12	REEF	239	4,620	4,779	1,039	111	10,788	2	43	44	10	1
14	POL	239	4,703	4,883	1,039	111	10,975	2	43	45	9	1
14	TZR	264	5,218	5,158	1,075	111	11,826	2	44	44	9	1
15	NEP(east)	280	5,496	5,288	1,082	111	12,257	2	45	43	9	1
15	NEP(west)	303	5,849	5,441	1,082	111	12,786	2	46	43	8	1
16	ZAP	371	6,678	5,873	1,108	111	14,141	3	47	41	8	1
17	REEF	453	7,187	6,061	1,130	111	14,942	3	48	40	8	1
17	L-K	459	7,262	6,160	1,143	111	15,135	3	48	40	8	1
18	NEP(east)	556	7,859	6,443	1,153	111	16,122	3	49	40	7	1
18	NEP(west)	582	8,064	6,527	1,179	116	16,468	3	49	40	7	1
19	POL	601	8,141	6,693	1,205	116	16,756	4	48	40	7	1
19	TZR	601	8,435	6,870	1,237	116	17,259	3	49	40	7	1
22	ZAP	785	9,585	7,303	1,259	116	19,048	4	50	38	7	1
23	REEF	931	10,253	7,653	1,289	121	20,247	4	51	38	6	1
23	L-K	971	10,469	7,699	1,294	121	20,554	5	51	37	6	1
24	TZR	976	10,603	7,776	1,299	121	20,775	5	51	37	6	1
24	POL	1,013	10,849	7,890	1,306	121	21,179	5	51	37	6	1
25	NEP(east)	1,151	11,541	8,190	1,316	121	22,319	5	52	36	6	1
25	NEP(west)	1,201	11,760	8,319	1,327	121	22,728	5	52	36	6	1
26	ZAP	1,360	12,573	8,683	1,350	121	24,087	5	52	36	6	1
28	REEF	1,654	13,569	8,973	1,371	121	25,688	6	53	35	5	1
29	POL	1,783	14,392	9,419	1,411	121	27,126	7	53	35	5	-
29	TZR	1,794	14,542	9,574	1,411	121	27,442	7	53	35	5	-
29	L-K	1,853	14,704	9,623	1,411	121	27,712	7	53	35	5	-
30	NEP(east)	1,954	15,316	9,774	1,421	121	28,586	7	54	34	5	-
30	NEP(west)	1,978	15,415	9,817	1,421	121	28,752	7	54	34	5	-
30	TZR	2,030	15,833	9,910	1,421	121	29,315	7	54	34	5	-
31	ZAP	2,272	16,934	10,367	1,437	121	31,131	7	55	33	5	-
Aug.												
1	REEF	2,571	17,532	10,471	1,464	121	32,159	8	54	33	5	-
1	L-K	2,640	17,826	10,565	1,469	121	32,621	8	55	32	5	-

1/ NEP(east)=east or Morjovi side of Northeast Point; NEP(west)=west or Vostochni side of Northeast Point; TZR=Tolstoi, Zapadni Reef, and Little Zapadni; POL=Polovina and Little Polovina; ZAP=Zapadni; REEF=Reef, Gorbatch, and Ardiguen; L-K=Lukanin and Kitovi.

Table A-3. --Age classification of male seals killed on St. George Island, 25 June to 1 August 1969

Date	Rookery[1/]	Males killed	Tooth sample	Seals in each age group of sample					Estimated seals killed from each age group				
				2	3	4	5	6	2	3	4	5	6
		Number	Number	Percent					Number				
June													
25	NOR	135	27	-	11.1	51.9	29.6	7.4	-	15	60	50	10
27	STAR	54	11	-	18.2	27.3	45.4	9.1	-	10	15	24	5
27	ZAP	167	32	3.1	15.6	34.4	28.1	18.8	5	26	58	47	31
30	EAST	63	13	7.7	-	69.2	15.4	7.7	5	-	43	10	5
July													
2	ZAP	180	37	-	32.4	43.3	21.6	2.7	-	58	68	49	5
2	STAR	39	8	-	12.5	37.5	50.0	-	-	5	15	19	-
3	NOR	89	18	-	38.9	44.4	16.7	-	-	35	39	15	-
7	ZAP	108	22	-	31.8	50.0	18.2	-	-	34	54	20	-
7	STAR	82	16	-	6.2	68.8	18.8	6.2	-	5	57	15	5
9	NOR	254	51	2.0	33.3	52.9	11.8	-	5	65	154	30	-
9	EAST	118	24	4.1	41.7	41.7	12.5	-	5	49	49	15	-
11	ZAP	72	15	-	53.4	20.0	13.3	13.3	-	38	14	10	10
11	STAR	47	9	-	11.1	66.7	22.2	-	-	5	31	11	-
14	NOR	284	57	1.8	35.1	49.1	10.5	3.5	5	70	169	30	10
14	EAST	260	52	1.9	50.0	40.4	7.7	-	5	130	105	20	-
15	ZAP	135	27	3.7	48.2	33.3	11.1	3.7	5	65	45	15	5
15	STAR	145	24	-	37.5	45.8	12.5	4.2	-	54	67	18	6
18	EAST	341	67	1.5	49.3	35.8	11.9	1.5	5	168	122	41	5
18	NOR	269	53	3.8	47.2	37.7	9.4	1.9	10	127	102	25	5
21	STAR	102	18	-	38.9	50.0	11.1	-	-	40	51	11	-
21	ZAP	187	38	2.6	55.3	34.2	5.3	2.6	5	103	64	10	5
23	EAST	172	29	6.9	31.0	41.4	20.7	-	12	53	61	46	-
23	NOR	269	52	5.8	25.0	61.5	7.7	-	16	67	165	21	-
25	ZAP	113	22	13.6	54.6	27.3	4.5	-	15	62	31	5	-
25	NOR	123	24	4.2	45.8	41.7	8.3	-	5	57	51	10	-
28	EAST	450	87	16.1	56.3	21.8	5.8	-	73	253	78	46	-
28	NOR	639	123	14.6	54.5	26.8	3.3	0.8	73	368	172	21	5
30	STAR	139	31	22.6	54.8	22.6	-	-	31	76	32	-	-
30	ZAP	113	22	4.6	68.2	13.6	13.6	-	5	78	15	15	-
30	NOR	103	20	10.0	45.0	45.0	-	-	11	46	46	-	-
Aug.													
1	EAST	395	80	16.2	62.5	17.5	3.8	-	64	247	69	15	-
1	NOR	410	80	12.5	57.5	25.0	3.8	1.2	51	236	102	16	5
Season total		6,057	1,189						411	2,645	2,204	680	117

1/ ZAP=Zapadni and South; EAST=East Reef and East Cliffs NOR North STAR=Staraya Artil.

Table A-4. --Cumulative age classification of male seals killed on St. George Island, 25 June to 1 August 1969

Date	Rookery[1/]	Estimated seals killed from each age group					Total kill	Seals killed from each age group				
		2	3	4	5	6		2	3	4	5	6
		Number						Percent				
June												
25	NOR	-	15	60	50	10	135	-	11	44	37	8
27	STAR	-	25	75	74	15	189	-	13	40	39	8
27	ZAP	5	51	133	121	46	356	1	14	38	34	13
30	EAST	10	51	176	131	51	419	2	12	42	32	12
July												
2	ZAP	10	109	244	180	56	599	2	18	41	30	9
2	STAR	10	114	259	199	56	638	2	18	40	31	9
3	NOR	10	149	298	214	56	727	1	21	41	29	8
7	ZAP	10	183	352	234	56	835	1	22	42	28	7
7	STAR	10	188	409	249	61	917	1	20	45	27	7
9	NOR	15	253	563	279	61	1,171	1	22	48	24	5
9	EAST	20	302	612	294	61	1,289	2	23	47	23	5
11	ZAP	20	340	626	304	71	1,361	1	25	47	22	5
11	STAR	20	345	657	315	71	1,408	1	25	47	22	5
14	NOR	25	415	826	345	81	1,692	1	25	49	20	5
14	EAST	30	545	931	365	81	1,952	1	28	48	19	4
15	ZAP	35	610	976	380	86	2,087	2	29	47	18	4
15	STAR	35	664	1,043	398	92	2,232	2	29	47	18	4
18	EAST	40	832	1,165	439	97	2,573	2	32	45	17	4
18	NOR	50	959	1,267	464	102	2,842	2	34	44	16	4
21	STAR	50	999	1,318	475	102	2,944	2	34	45	16	3
21	ZAP	55	1,102	1,382	485	107	3,131	2	34	45	16	3
23	EAST	67	1,155	1,443	531	107	3,303	2	34	45	16	3
23	NOR	83	1,222	1,608	552	107	3,572	2	34	45	16	3
25	ZAP	98	1,284	1,639	557	107	3,685	3	35	44	15	3
25	NOR	103	1,341	1,690	567	107	3,808	3	35	44	15	3
28	EAST	176	1,594	1,768	613	107	4,258	4	38	42	14	2
28	NOR	249	1,962	1,940	634	112	4,897	5	40	40	13	2
30	STAR	280	2,038	1,972	634	112	5,036	6	40	39	13	2
30	ZAP	285	2,116	1,987	649	112	5,149	6	41	38	13	2
30	NOR	296	2,162	2,033	649	112	5,252	6	41	39	12	2
Aug.												
1	EAST	360	2,409	2,102	664	112	5,647	6	43	37	12	2
1	NOR	411	2,645	2,204	680	117	6,057	7	44	36	11	2

1/ ZAP=Zapadni and South; EAST=East Reef and East Cliffs; NOR=North; STAR=Staraya Artil.

Table A-5 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 20-24 June 1969

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Lukanin															
1	-	4	-	-	-	-	-	-	-	-	-	-	-	-	4
2	27	24	-	-	-	-	-	-	-	-	-	-	-	-	51
3	18	16	-	-	-	-	-	-	-	-	-	-	-	-	34
4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
5	28	-	-	-	-	-	-	-	-	-	-	-	-	-	28
Kitovi[2/]															
1	-(0)	1	3	4	2	-	-	-	-	-	-	-	-	-	10
2	18(16)	9	36	35	42	-	-	-	-	-	-	-	-	-	156
3	23(6)	7	12	19	9	-	-	-	-	-	-	-	-	-	76
4	-(0)	1	1	-	-	-	-	-	-	-	-	-	-	-	2
5	-(0)	-	-	-	52	-	-	-	-	-	-	-	-	-	52
Reef															
1	12	19	8	5	3	12	-	10	7	1	-	-	-	-	77
2	52	66	57	32	34	38	87	56	40	32	14	-	-	-	508
3	15	33	15	15	19	30	6	29	18	24	18	-	-	-	222
4	1	4	-	2	3	1	-	-	-	-	-	-	-	-	11
5	3	-	-	-	118	-	-	-	-	-	54	-	-	-	175
Gorbatch															
1	8	7	4	1	4	7	-	-	-	-	-	-	-	-	31
2	45	40	42	18	34	71	-	-	-	-	-	-	-	-	250
3	35	35	26	4	22	24	-	-	-	-	-	-	-	-	146
4	7	2	2	3	7	2	-	-	-	-	-	-	-	-	23
5	161	-	-	41	-	-	-	-	-	-	-	-	-	-	202
Ardiguen[3/]															
1															3
2															59
3															27
4															-
5															64
Sivutch[3/]															
1															72
2															297
3															214
4															-
5															312
Morjovi[4/]															
1	5(2)	3	6	6	4	4	-	-	-	-	-	-	-	-	28
2	42(17)	25	25	42	36	49	-	-	-	-	-	-	-	-	219
3	20(13)	28	15	32	24	28	-	-	-	-	-	-	-	-	147
4	-(0)	1	1	1	-	-	-	-	-	-	-	-	-	-	3
5	165(2)	-	-	-	-	24	-	-	-	-	-	-	-	-	189
Vostochni															
1	-	1	6	1	1	5	1	3	7	-	5	2	4	3	39
2	53	19	28	24	28	70	34	59	62	39	42	66	62	20	605
3	19	30	26	14	19	34	19	35	32	20	25	40	31	16	360
4	-	-	-	2	1	1	-	5	-	-	1	-	1	-	11
5	75	-	-	43	-	-	60	-	5	1	-	83	9	30	306

See footnotes at end of table.

Table A-5 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 20-24 June 1969--Continued

Rookery and class of male	Section													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Little Polovina															
1	2	3	-	-	-	-	-	-	-	-	-	-	-	-	5
2	42	41	-	-	-	-	-	-	-	-	-	-	-	-	83
3	8	20	-	-	-	-	-	-	-	-	-	-	-	-	28
4	6	5	-	-	-	-	-	-	-	-	-	-	-	-	11
5	-	38	-	-	-	-	-	-	-	-	-	-	-	-	38
Polovina															
1	9	6	-	-	-	-	-	-	-	-	-	-	-	-	15
2	59	30	-	-	-	-	-	-	-	-	-	-	-	-	89
3	15	10	-	-	-	-	-	-	-	-	-	-	-	-	25
4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
5	43	-	-	-	-	-	-	-	-	-	-	-	-	-	43
Polovina Cliffs															
1	3	3	2	2	9	5	9	-	-	-	-	-	-	-	33
2	26	46	24	36	48	36	79	-	-	-	-	-	-	-	295
3	16	7	14	11	20	17	20	-	-	-	-	-	-	-	105
4	-	-	-	-	1	2	-	-	-	-	-	-	-	-	3
5	-	-	-	-	-	65	-	-	-	-	-	-	-	-	65
Tolstoi															
1	6	3	8	3	6	5	4	5	-	-	-	-	-	-	40
2	46	41	55	21	66	61	61	60	-	-	-	-	-	-	411
3	16	14	12	10	22	23	19	14	-	-	-	-	-	-	130
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	133	-	-	-	-	-	-	133
Zapadni Reef															
1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
2	47	20	-	-	-	-	-	-	-	-	-	-	-	-	67
3	29	17	-	-	-	-	-	-	-	-	-	-	-	-	46
4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
5	4	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Little Zapadni															
1	4	6	10	7	5	5	-	-	-	-	-	-	-	-	37
2	21	31	42	39	42	44	-	-	-	-	-	-	-	-	219
3	11	14	32	30	21	19	-	-	-	-	-	-	-	-	127
4	11	2	-	1	4	-	-	-	-	-	-	-	-	-	18
5	-	-	-	-	-	61	-	-	-	-	-	-	-	-	61
Zapadni[5/]															
1	1(0)	5	6	8	8	12	9	2	-	-	-	-	-	-	51
2	44(0)	82	49	91	59	55	64	21	-	-	-	-	-	-	465
3	20(0)	41	32	29	26	37	23	11	-	-	-	-	-	-	219
4	-(0)	7	-	-	1	1	1	-	-	-	-	-	-	-	10
5	2(120)	-	-	-	-	-	-	382	-	-	-	-	-	-	504

1/ Class 1 Shoreline - Full-grown males about age 10 and older without females but apparently with established territories at the high tide mark.

Class 2 Territorial without females - Full-grown males about age 10 and older without females but with established territories on the rookery.

Class 3 Territorial with females - Full-grown males about age 10 and older with females and established territories on the rookery.

Class 4 Back fringe - Full-grown and partly grown males about age 7 and older without females and territories that are found along the inland fringe of the rookery.

Class 5 Hauling ground - Full-grown and partly grown males about age 7 and older without females that are found on traditional hauling grounds.

Class 3 males were formerly called harem bulls, and Classes 1, 2, 4, and 5 were collectively called idle bulls.

2/ Numbers in parentheses are the adult males counted in Kitovi Amphitheater.

3/ No numbered sections.

4/ Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.

5/ Numbers in parentheses are the adult males counted on Zapadni Point Reef.

Table A-6 . --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-12 July 1969

Rookery and class of male	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
Lukanin															
1	1	3	-	-	-	-	-	-	-	-	-	-	-	-	4
2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	5
3	41	55	-	-	-	-	-	-	-	-	-	-	-	-	96
4	3	1	-	-	-	-	-	-	-	-	-	-	-	-	4
5	33	-	-	-	-	-	-	-	-	-	-	-	-	-	33
Kitovi[2/]															
1	8(5)	5	5	7	1	-	-	-	-	-	-	-	-	-	31
2	-(3)	-	5	3	2	-	-	-	-	-	-	-	-	-	13
3	52(25)	21	59	72	56	-	-	-	-	-	-	-	-	-	285
4	-(0)	-	-	4	-	-	-	-	-	-	-	-	-	-	4
5	-(0)	-	-	-	43	-	-	-	-	-	-	-	-	-	43
Reef															
1	10	7	5	3	5	8	-	7	4	1	-	-	-	-	50
2	18	14	7	7	5	8	25	3	11	5	5	-	-	-	108
3	71	97	75	44	57	67	63	75	64	69	41	-	-	-	723
4	1	20	2	7	-	-	6	2	-	1	-	-	-	-	39
5	-	1	-	-	182	-	-	-	-	-	77	-	-	-	260
Gorbatch															
1	7	10	12	6	8	8	-	-	-	-	-	-	-	-	51
2	17	-	3	6	1	11	-	-	-	-	-	-	-	-	38
3	88	81	68	32	60	97	-	-	-	-	-	-	-	-	426
4	5	3	2	-	-	10	-	-	-	-	-	-	-	-	20
5	63	-	-	37	-	-	-	-	-	-	-	-	-	-	100
Ardiguen[3/]															
1															8
2															12
3															118
4															-
5															70
Sivutch[3/]															
1															53
2															51
3															461
4															-
5															223
Morjovi[4/]															
1	5(0)	13	3	11	6	7	-	-	-	-	-	-	-	-	45
2	2(4)	3	1	2	6	8	-	-	-	-	-	-	-	-	26
3	60(33)	53	49	84	71	73	-	-	-	-	-	-	-	-	423
4	2(0)	-	10	8	-	-	-	-	-	-	-	-	-	-	20
5	-(30)	-	-	-	-	-	-	-	-	-	-	-	-	-	30
Vostochni															
1	2	5	7	4	2	7	2	9	6	1	2	6	6	3	62
2	9	3	4	3	2	14	5	10	11	9	4	9	11	5	99
3	67	42	52	39	42	102	46	86	88	52	71	87	95	44	913
4	1	-	-	-	-	-	-	1	2	-	-	-	1	-	5
5	57	-	-	-	30	11	35	-	-	-	-	51	4	12	200

See footnotes at end of table.

Table A-6 --Adult male seals counted, by class[1/] and rookery section, St. Paul Island, 10-12 July 1969--Continued

Rookery and class of male	Section 1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
	Number														
Little Polovina															
1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	5
2	7	15	-	-	-	-	-	-	-	-	-	-	-	-	22
3	54	75	-	-	-	-	-	-	-	-	-	-	-	-	129
4	1	2	-	-	-	-	-	-	-	-	-	-	-	-	3
5	-	36	-	-	-	-	-	-	-	-	-	-	-	-	36
Polovina															
1	9	6	-	-	-	-	-	-	-	-	-	-	-	-	15
2	13	6	-	-	-	-	-	-	-	-	-	-	-	-	19
3	60	34	-	-	-	-	-	-	-	-	-	-	-	-	94
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	69	-	-	-	-	-	-	-	-	-	-	-	-	-	69
Polovina Cliffs															
1	2	3	2	2	2	3	7	-	-	-	-	-	-	-	21
2	4	8	5	5	7	4	12	-	-	-	-	-	-	-	45
3	47	73	35	57	75	64	112	-	-	-	-	-	-	-	463
4	1	3	-	6	2	6	1	-	-	-	-	-	-	-	19
5	2	-	-	-	-	37	2	-	-	-	-	-	-	-	41
Tolstoi															
1	6	4	5	5	10	7	6	2	-	-	-	-	-	-	45
2	1	1	-	-	8	6	10	10	-	-	-	-	-	-	36
3	62	72	61	71	112	100	79	81	-	-	-	-	-	-	638
4	-	2	-	-	2	-	-	11	-	-	-	-	-	-	15
5	-	-	-	-	-	-	-	103	-	-	-	-	-	-	103
Zapadni Reef															
1	5	1	-	-	-	-	-	-	-	-	-	-	-	-	6
2	4	2	-	-	-	-	-	-	-	-	-	-	-	-	6
3	80	35	-	-	-	-	-	-	-	-	-	-	-	-	115
4	1	2	-	-	-	-	-	-	-	-	-	-	-	-	3
5	1	26	-	-	-	-	-	-	-	-	-	-	-	-	27
Little Zapadni															
1	-	3	4	10	9	2	-	-	-	-	-	-	-	-	28
2	1	1	1	8	6	1	-	-	-	-	-	-	-	-	18
3	38	50	83	74	72	44	-	-	-	-	-	-	-	-	361
4	1	2	4	2	4	7	-	-	-	-	-	-	-	-	20
5	-	-	-	-	-	16	-	-	-	-	-	-	-	-	16
Zapadni[5/]															
1	2(0)	3	3	4	7	7	3	-	-	-	-	-	-	-	29
2	7(0)	14	8	14	12	9	11	2	-	-	-	-	-	-	77
3	64(2)	120	85	120	82	101	80	29	-	-	-	-	-	-	683
4	3(0)	8	2	7	1	2	-	6	-	-	-	-	-	-	29
5	-(75)	-	-	-	-	-	-	75	-	-	-	-	-	-	75

1/ For description of classes, see table A-5 or glossary.

2/ Numbers in parentheses are the adult males counted in Kitovi Amphitheater.

3/ No numbered sections.

4/ Numbers in parentheses are the adult males counted on the second point south of Sea Lion Neck.

5/ Numbers in parentheses are the adult males counted on Zapadni Point Reef.

Table A-7. --Adult male seals counted, by class[1/] and rookery section, St. George Island, 20-21 June 1969

Rookery and class of male	Section						Total
	1	2	3	4	5	6	
	Number						
Zapadni							
1	7	3	-	-	-	-	10
2	59	78	19	-	-	-	156
3	32	15	-	-	-	-	47
4	11	4	1	-	-	-	16
5	133	-	-	-	-	-	133
South							
1	19	6	10	-	-	-	35
2	154	72	83	-	-	-	309
3	27	35	25	-	-	-	87
4	-	-	-	-	-	-	-
5	--	-	-	-	-	-	-
North							
1	2	4	4	6	5	7	28
2	25	43	38	61	20	84	271
3	32	30	37	25	19	23	166
4	-	4	5	-	2	2	13
5	30	-	-	3	-	17	50
East Reef[2/]							
1	-	-	-	-	-	-	11
2	-	-	-	-	-	-	52
3	-	-	-	-	-	-	25
4	-	-	-	-	-	-	3
5	-	-	-	-	-	-	42
East Cliffs							
1	9	3	-	-	-	-	12
2	47	39	-	-	-	-	86
3	44	28	-	-	-	-	72
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
Staraya Artil							
1	5	-	-	-	-	-	5
2	110	50	-	-	-	-	160
3	25	-	-	-	-	-	25
4	-	-	-	-	-	-	-
5	28	-	-	-	-	-	28

1/ See table A-5 or glossary for a description of the classes of adult male seals.

2/ No numbered sections.

Table A-8. --Adult male seals counted, by class[1/] and rookery section, St. George Island, 10-12 July 1969

Rookery and class of male	Section						Total
	1	2	3	4	5	6	
	Number						
Zapadni							
1	5	4	4	-	-	-	13
2	12	17	25	-	-	-	54
3	66	85	32	-	-	-	183
4	6	8	9	-	-	-	23
5	141	-	-	-	-	-	141
South							
1	11	6	9	-	-	-	26
2	18	13	21	-	-	-	52
3	80	93	77	-	-	-	250
4	-	-	-	-	-	-	-
5	43	-	-	-	-	-	43
North							
1	3	3	7	6	5	7	31
2	1	3	5	6	6	5	26
3	72	96	103	106	47	102	526
4	6	1	1	4	3	26	41
5	41	-	-	-	-	37	78
East Reef[2/]							
1	-	-	-	-	-	-	9
2	-	-	-	-	-	-	18
3	-	-	-	-	-	-	100
4	-	-	-	-	-	-	6
5	-	-	-	-	-	-	6
East Cliffs							
1	5	6	-	-	-	-	11
2	10	13	-	-	-	-	23
3	100	115	-	-	-	-	215
4	2	4	-	-	-	-	6
5	4	-	-	-	-	-	4
Staraya Artil							
1	5	-	-	-	-	-	5
2	22	28	-	-	-	-	50
3	126	57	-	-	-	-	183
4	-	-	-	-	-	-	-
5	11	-	-	-	-	-	11

1/ See table A-5 or the glossary for a description of the classes of adult male seals.

2/ No numbered sections.

Table A-9. --Harem and idle male seals counted in mid-July, Pribilof Islands, Alaska, 1960-69

Year	St. Paul Island		St. George Island		Both islands	
	Harem	Idle	Harem	Idle	Harem	Idle
	----Number----		----Number----		----Number----	
1960	10,247	10,407	2,552	2,630	12,799	13,037
1961	11,163	11,791	2,843	2,489	14,006	14,280
1962	10,332	9,109	2,342	2,650	12,674	11,759
1963	9,212	7,650	2,071	1,890	11,283	9,540
1964	9,085	7,095	1,989	1,489	11,074	8,584
1965	8,553	5,616	1,917	1,113	10,470	6,729
1966	7,974	5,839	1,974	1,017	9,948	6,856
1967	1/ 7,230	1/ 4,439	1,646	1,268	8,876	5,707
1968	1/ 6,176	1/ 3,100	1,748	1,283	7,924	4,383
1969	2/ 5,928	2/ 2,535	1,457	677	7,385	3,212

1/ Harem and idle males on St. Paul Island were counted on Reef, Lukanin, Kitovi, Tolstoi, and Zapadni Reef Rookeries in 1967 and on Reef, Zapadni Reef, Vostochni, and Morjovi Rookeries in 1968, then extrapolated to produce counts representing all the rookeries.

2/ Includes harem and idle males counted on Sivutch Rookery (Sea Lion Rock).

Table A-10. --Adult male seals counted, St. Paul Island, 9-14 July 1966-69

Rookery	Year and class of adult male seal 1/							
	1966		1967		1968		1969	
	Harem	Idle	Harem	Idle	Harem	Idle	Harem	Idle
	----Number----							
Lukanin	152	108	137	77	-	-	96	46
Kitovi	413	194	374	118	-	-	285	91
Reef	1,070	678	927	616	843	514	723	457
Gorbatch	607	521	-	-	-	-	426	209
Ardiguen	92	97	-	-	-	-	118	90
Morjovi	645	534	-	-	505	191	423	121
Vostochni	1,449	970	-	-	1,116	497	913	366
Little Polovina	218	312	-	-	-	-	129	66
Polovina	188	405	-	-	-	-	94	103
Polovina Cliffs	619	295	-	-	-	-	463	126
Tolstoi	819	441	791	283	-	-	638	199
Zapadni Reef	203	210	180	146	144	68	115	42
Little Zapadni	542	227	-	-	-	-	361	82
Zapadni	957	847	-	-	-	-	683	210
Total	7,974	5,839	2,409	1,240	2,608	1,270	5,467	2,208

1/ Harem=class 3; idle=classes 1, 2, 4, and 5 (see table A-5 or the glossary for a description of the classes of adult males).

Table A-11.--Adult male seals counted, St. Paul Island, 20-27 June 1966-69

Year and rookery	Class of adult male[1/] 1	2	3	4	5	Total
			Number			
1966						
Lukanin	13	83	67	-	84	247
Kitovi	22	229	193	4	102	550
Reef	119	852	333	-	425	1,729
Gorbatch	78	441	180	62	362	1,123
Ardiguen	8	40	53	9	50	160
Morjovi	108	452	230	3	464	1,257
Vostochni	92	1,019	522	18	542	2,193
Little Polovina	12	162	73	29	254	530
Polovina	75	168	65	-	253	561
Polovina Cliffs	48	494	202	5	81	830
Tolstoi	65	622	233	-	131	1,051
Zapadni Reef	13	142	65	-	146	366
Little Zapadni	70	339	150	-	133	692
Zapadni	149	716	275	-	521	1,661
Total	872	5,759	2,641	130	3,548	12,950
1967						
Lukanin	12	93	53	4	51	213
Kitovi	17	211	144	4	91	467
Reef	72	752	272	18	241	1,355
Gorbatch	43	407	159	25	236	870
Ardiguen	6	49	39	-	58	152
Morjovi	41	394	189	73	249	946
Vostochni	109	940	333	147	557	2,086
Little Polovina	7	143	51	27	150	378
Polovina	27	150	43	25	185	430
Polovina Cliffs	38	408	192	68	47	753
Tolstoi	80	455	251	24	472	1,282
Zapadni Reef	13	125	52	13	64	267
Little Zapadni	42	328	184	28	120	702
Zapadni	74	611	277	82	353	1,397
Total	581	5,066	2,239	538	2,874	11,298

See footnote end of table.

Table A-11.--Adult male seals counted, St. Paul Island, 20-27 June 1966-69--Continued

Year and rookery	Class of adult male[1/] 1	2	3	4	5	Total
	Number					
1968						
Lukanin	8	62	45	1	15	131
Kitovi	31	179	122	-	49	381
Reef	57	616	255	42	400	1,370
Gorbatch	32	341	128	25	242	768
Ardiguen	2	62	42	-	50	156
Morjovi	35	309	228	21	146	739
Vostochni	67	804	462	11	389	1,733
Little Polovina	12	107	71	14	75	279
Polovina	8	89	68	1	177	343
Polovina Cliffs	52	315	256	16	74	713
Tolstoi	49	350	309	25	150	883
Zapadni Reef	3	72	75	3	59	212
Little Zapadni	27	218	234	9	84	572
Zapadni	55	508	357	34	300	1,254
Total	438	4,032	2,652	202	2,210	9,534
1969						
Lukanin	4	51	34	2	28	119
Kitovi	10	156	76	2	52	296
Reef	77	508	222	11	175	993
Gorbatch	31	250	146	23	202	652
Ardiguen	3	59	27	-	64	153
Morjovi	30	236	160	3	191	620
Vostochni	39	605	360	11	306	1,321
Little Polovina	5	83	28	11	38	165
Polovina	15	89	25	1	43	173
Polovina Cliffs	33	295	105	3	65	501
Tolstoi	40	411	130	-	133	714
Zapadni Reef	3	67	46	1	4	121
Little Zapadni	37	219	127	18	61	462
Zapadni	51	465	219	10	504	1,249
Total	378	3,494	1,705	96	1,866	7,539

1/ See table A-5 or the glossary for a description of the classes of adult male seals.

Table A-12.--Dead seal pups counted, [1] by rookery, Pribilof Islands, Alaska, 1960-69

Island and rookery	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
	Number									
St. Paul Island										
Morjovi	6,825	5,259	4,881	2,348	1,830	2,649	1,686	1,072	2,285	734
Vostochni	11,333	10,173	8,565	5,057	3,404	4,214	2,785	1,969	4,195	1,711
Little Polovina	2,427	2,415	2,121	923	631	1,132	449	233	509	200
Polovina Cliffs	3,462	4,576	2,957	2,160	1,097	2,856	809	825	1,616	836
Polovina	5,268	2,499	1,880	1,237	783	1,176	312	319	487	327
Ardiguen	331	411	225	141	102	459	160	90	118	112
Gorbatch	3,168	3,550	1,373	2,431	1,549	3,123	1,593	874	1,446	823
Reef	9,664	10,047	7,897	5,688	3,000	7,664	3,562	2,008	3,064	1,365
Kitovi	2,006	2,215	2,081	881	462	2,202	406	522	755	652
Lukanin	1,037	1,294	660	546	402	1,126	432	240	597	460
Tolstoi	5,237	4,761	3,004	3,274	2,614	3,955	3,425	2,251	3,315	2,778
Little Zapadni	4,148	3,047	2,399	2,580	1,101	2,461	1,634	1,098	1,781	798
Zapadni Reef	1,472	1,291	598	718	425	723	451	380	685	177
Zapadni	6,450	6,329	6,627	4,614	4,172	5,384	3,710	2,195	4,445	2,306
Counted total	62,828	57,867	45,268	32,598	21,572	39,124	21,414	14,076	25,298	13,279
Estimated oversight 5%	2,946	2,893	2,263	1,630	1,079	1,956	1,071	704	1,265	664
Total	65,774	60,760	47,531	34,228	22,651	41,080	22,485	14,780	26,563	13,943
St. George Island										
North	3,489	3,883	2,242	2,525	792	1,854	1,561	971	1,567	444
Zapadni	1,902	2,019	1,740	704	446	1,263	1,196	578	1,197	260
East	1,112	1,347	504	502	272	676	764	201	824	187
Staraya Artil	2,000	2,514	1,435	1,041	767	1,186	1,152	770	1,055	640
Counted total	8,503	9,763	5,921	4,772	2,277	4,979	4,673	2,520	4,643	1,531
Estimated oversight 5%	425	488	296	239	114	249	234	126	232	76
Total	8,928	10,251	6,217	5,011	2,391	5,228	4,907	2,646	4,875	1,607
Pribilof Islands counted total [2]	71,331	67,630	51,189	37,370	23,849	44,103	26,087	16,596	29,941	14,810
Estimated oversight 5%	3,371	3,381	2,559	1,869	1,193	2,205	1,305	830	1,497	740
Total	74,702	71,011	53,748	39,239	25,042	46,308	27,392	17,426	31,438	15,550

1/ The dead pups are counted after 15 August each year; most mortality has occurred by that date.

2/ Not included in the total are 2,228 dead pups counted on Sea Lion Rock (Sivutch) in 1966.

Table A-13. --Dead seal pups counted, by rookery sections, Pribilof Islands, Alaska, 25-27 August 1969

Island and rookery	Section														Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Number														
St. Paul Island															
Morjovi	1/ 376	80	53	98	63	64	-	-	-	-	-	-	-	-	734
Vostochni	50	40	54	84	202	302	144	221	159	49	70	73	191	72	1,711
Little Polovina	97	103	-	-	-	-	-	-	-	-	-	-	-	-	200
Polovina Cliffs	130	82	105	106	124	118	171	-	-	-	-	-	-	-	836
Polovina	221	106	-	-	-	-	-	-	-	-	-	-	-	-	327
Ardiguen 2/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112
Gorbatch	199	242	125	73	90	94	-	-	-	-	-	-	-	-	823
Reef	105	107	190	128	75	156	214	153	99	87	51	-	-	-	1,365
Kitovi	3/ 153	35	179	180	105	-	-	-	-	-	-	-	-	-	652
Lukanin	181	279	-	-	-	-	-	-	-	-	-	-	-	-	460
Tolstoi	161	160	180	103	344	516	625	689	-	-	-	-	-	-	2,778
Little Zapadni	73	134	170	186	134	101	-	-	-	-	-	-	-	-	798
Zapadni Reef	43	134	-	-	-	-	-	-	-	-	-	-	-	-	177
Zapadni	164	336	500	508	221	198	291	88	-	-	-	-	-	-	2,306
Total															13,279
St. George Island															
North	37	66	91	88	20	142	-	-	-	-	-	-	-	-	444
Zapadni	74	74	32	-	-	-	-	-	-	-	-	-	-	-	180
South	21	34	25	-	-	-	-	-	-	-	-	-	-	-	80
East Reef 2/	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62
East Cliffs	64	61	-	-	-	-	-	-	-	-	-	-	-	-	125
Staraya Artil	535	105	-	-	-	-	-	-	-	-	-	-	-	-	640
Total															1,531
Grand total															14,810

1/ Includes 47 dead pups counted on point south of Sea Lion Neck.

2/ No numbered sections.

3/ Includes 40 dead pups counted in amphitheater.

Table A-14. --Primary diagnoses for causes of death among 208 seal pups, by 7-day periods, St. Paul Island, 26 June to 15 August 1969

Cause of death	To 27 June	28 June to 4 July	5-11 July	12-18 July	19-25 July	26 July to 1 Aug.	2-8 Aug.	9-15 Aug.	Total
	Number								
Malnutrition	0	4	6	8	10	9	12	7	56
Hookworm disease	0	0	0	2	14	24	11	7	58
Microbial infection	1	3	5	8	3	1	2	1	24
Trauma	0	7	3	2	0	0	1	0	13
Perinatal complex	0	3	5	0	3	0	0	0	11
Miscellaneous	0	1	1	1	3	0	1	0	7
Undetermined	0	1	2	6	3	6	0	1	19
Total	1	19	22	27	36	40	27	16	188
Unsuitable for examination	2	2	2	3	2	9	0	0	20
Total	3	21	24	30	38	49	27	16	208
Advanced post mortem degeneration	2	8	6	12	10	20	8	5	71

Table A-15.--Lesions and circumstances associated with cases of multiple hemorrhage-perinatal complex, St. Paul Island, 1964 and 1966-69

Date and study area	Pups examined	Pups affected		No bite wounds or contusions	Subcapsular hemorrhage of liver and other organs	Focal necrosis of the liver	Intraocular hemorrhage	Stillborn	Placenta or fresh cord attached
		Number	Percent						
9 July to 22 Aug. 1964									
Reef									
Old catwalk	109	6	5.5	1	-	-	1	1	3
28 June to 22 Aug. 1966									
Reef									
Old catwalk	164	5	3.0	3	-	-	-	1	2
29 June to 15 Aug. 1967									
Reef									
Old catwalk	80	14)		2	3	1	3	3	10
New catwalk	54	10)	17.2	5	3	2	1	2	8
NEP	98	16)		8	3	2	4	6	14
Total	232	1/40		15	9	5	8	11	32
Percent				37.5	22.5	12.5	20.0	27.5	80.0
4 July to 15 Aug. 1968									
Reef									
Old catwalk	132	4)		1	1	1	2	1	3
New catwalk	97	9)	5.0	6	1	1	4	4	5
NEP	150	6)		3	1	1	2	2	4
Total	379	19		10	3	3	8	7	12
Percent				52.6	16.7	16.7	44.4	38.9	66.7
26 June to 15 Aug. 1969									
Reef									
Old catwalk	66	7)		5	3	1	4	1	4
New catwalk	50	3)	6.7	3	-	-	-	-	3
NEP	92	4)		1	2	-	1	2	3
Total	208	2/14		9	5	1	5	3	10
Percent				64.3	35.7	7.1	35.7	21.4	71.4

1/ Includes 33 pups for which perinatal complex was the primary cause and 7 the secondary cause of death.

2/ Includes 11 pups for which perinatal complex was the primary cause and 3 the secondary cause of death.

Table A-16 -- Mean weights of untagged and unmarked seal pups about 1 September, St. Paul Island, 1957-69

[Numbers in parentheses show sample size]

Year	Sex	
	Males	Females
	Kg.	Kg.
1957	8.7 (391)	7.7 (351)
1958	11.4 (127)	9.9 (121)
1959	9.4 (444)	8.1 (386)
1960	9.8 (372)	9.1 (363)
1961	8.5 (381)	8.0 (466)
1962	9.2 (300)	8.2 (300)
1963	8.9 (300)	8.0 (300)
1964	9.1 (300)	7.7 (300)
1965	9.5 (300)	8.2 (300)
1966	9.6 (300)	8.4 (300)
1967	10.2 (400)	9.0 (400)
1968	9.6 (400)	8.3 (400)
1969	9.8 (400)	8.6 (400)
Mean 1957-69	9.5	8.4

Table A-17. --Seal pups tagged and marked, Pribilof Islands, Alaska, 1960-69

Year	Series	St. Paul Island	St. George Island	Location of tag	Checkmarks or marks
		------Number-------			
1960	M 1-12000		11,992	Right front flipper	Tip of right front flipper sliced off
	M 12001-60000	47,989		-------do. ------	Do.
1961	N 1-10000		9,988	Left front flipper	"V" notch near tip left front flipper
	N 10001-50000	39,933		------do. ------	Do.
1962	O 1-10000		9,980	Right front flipper	"V" notch near tip right front flipper
	O 10001-50000	39,928		------do. ------	Do.
1963	P 1-5000		4,993	Left front flipper	Tip of left front flipper sliced off
	P 5001-25000	19,978		------do. ------	Do.
1964	Q 1-5000		4,993	Right front flipper	Tip of right front flipper sliced off
	Q 5001-25000	19,998		------do. ------	Do.
1965	R 1-10000	10,000		Left front flipper	"V" notch near tip left front flipper
	Marked	10,007		Not tagged	"V" notch near tip right front flipper
	Marked	10,080		---do. ---	Tip of 1st digit (big toe) on right hind flipper sliced off
1966	S 1-2500		2,499	Left front flipper	Tip of left front flipper sliced off
	S 2501-12500	10,000		Right front flipper	Tip of 2d digit on right hind flipper sliced off
	Marked	9,578		Not tagged	Tip of 3d digit on right hind flipper sliced off
	Marked		2,503	---do. ---	Tip of 2d digit on left hind flipper sliced off
1967	T 9-2500		2,492	Right front flipper	Tip of right front flipper sliced off
	T 5001-15000	9,980		------do. ------	Do.
1968	U 1-2500		2,475	Left front flipper	"V" notch near tip left front flipper
	U 2501-12500	9,200		------do. ------	Do.
1969	Marked	20,000		Not tagged	Tip of 1st digit (big toe) on left hind flipper sliced off
	Marked		5,000	---do. ---	Tip of 1st digit (big toe) on right hind flipper sliced off

Table A-18. --Record of tags applied[1/] to male seals selected as yearlings and as 2-, 3-, and 4-year-olds on the basis of body length or size, St. Paul Island, 1961-63 and 1965-69

Age category and year	Tag series	Tag numbers	Effective tags[2/]
			Number
Yearlings[3/]			
1961	M	1-2000	754
1962	N	50001-51000	929
1963	O	50001-51000	799
1965	1R	1-1000	991
1966	1S	20001-21500	1,495
1967	1T	1-1500	835
1968	1U	20001-21500	714
Ages 2-4			
1966	2S	30001-31500	1,483
1967	2T	1-1500	1,220
1968	2U	30001-31500	1,495
Ages 1-4			
1969	1V	1-3431	3,419

1/ Each seal was double tagged; one tag was attached to each front flipper at the hairline (Fig. 9). Some seals with tags that had been attached to the animals when they were pups were given another tag.

2/ Total number of seals tagged within the series.

3/ Male and female seals were intentionally tagged in 1961, 1962, 1963, and 1965. Males only were intentionally tagged in 1966-69.

Table A-19. --Record of 119 male seals marked as pups in 1967 and 1968 or at ages 1 and 2 in 1968 and given 1V-series tags at age 1 and 2[1/] in 1969, St. Paul Island, 25 September to 13 October 1969

Seals marked as pups								
United States								
Tag attached				Tag lost (RFS)[2/]	U. S. S. R.		Seals marked at ages 1 and 2	
Age 1 tag (1V-series)	Pup tag (U-series)	Age 2 tag (1V-series)	Pup tag (T-series)	Age 2 (1V-series)	Age 1 tag (1V-series)	Pup tag	Age 1 tag (1V-series)	Age 1 tag in 1968 (1U-series)
283	9067	1891	8966	82	2535	AB-1479	586	20286
2768	5564	2003	6007	122	2767	AM-6592	1691	20412
2780	8120	2007	5277	188			2139	20406
		2215	10165	248				Age 2 tag
Age 2 tag (1V-series)	Pup tag (T-series)	2233	14169	273	Age 2 tag (1V-series)	Pup tag (X-series)	Age 2 tag (1V-series)	in 1968 (2U-series)
4	11301	2286	11993	475	1789	31671	338	30315
80	13782	2296	10132	604	2156	22688	2976	30405
84	2467	2364	10318	904				
166	11689	2369	2029	1492				
177	10287	2384	5891	1600				
181	12627	2405	5611	1639				
195	12540	2406	12711	1775				
220	12556	2419	12300	1536				
325	13038	2421	1091	1547				
381	9295	2441	6387	1716				
471	11489	2477	10289	1841				
528	5258	2554	8481	1950				
652	9624	2556	13092	2016				
731	12069	2723	12702	2288				
787	7285	2732	335	2360				
790	9878	2797	6483	2443				
850	12161	2852	11287	2841				
857	11678	2865	7373	2917				
887	13259	2936	10903	3103				
919	13764	2938	14366	3261				
948	9056	2972	10992	3281				
1054	6332	2994	13650	3287				
1058	12289	3000	9905	3306				
1225	6934	3017	9748	3337				
1235	14128	3134	8196					
1262	5375	3140	16063					
1284	13915	3142	6006					
1302	307	3164	6426					
1463	13920	3184	13180					
1545	14621	3194	10991					
1703	7970	3232	6883					
1840	5581	3248	49					
1845	7557	3264	12756					
1846	13282	3288	9077					
1853	6674	3340	5351					
1868	8752	3401	6063					
		3418	9336					

1/ Some seals that had lost one of two tags applied at ages 1 and 2 were given a 1V-series tag.

2/ Tip of right front flipper sliced off as a checkmark; these seals had originally been marked with T-series tags also.

Table A-20. --Record of 3,419 male seals tagged at ages 1 to 4 years, St. Paul Island, September and October 1969

Date	Area	Tag number (1V-series)	Effective tags[1/]
			Number
Sept.			
25	Northeast Point	1-250	249
26	English Bay and Zapadni	251-725	474
29	Northeast Point	726-900	174
29	English Bay and Zapadni	901-1200	300
30	English Bay and Zapadni	1201-1779	574
Oct.			
1	Zapadni	1780-1875	94
8	Northeast Point	1876-1900	25
1	Zapadni	1901-2025	125
1	Polovina	2026-2250	225
2	Northeast Point	2251-2375	125
2	English Bay and Zapadni	2376-2425	48
3	English Bay and Zapadni	2426-2575	150
3	Polovina	2576-2664	89
3	Northeast Point	2665-2700	36
7	English Bay and Zapadni	2701-2850	150
8	Northeast Point	2851-2889	39
8	Zapadni	2890-2925	36
10	English Bay	2926-3100	175
13	English Bay	3101-3431	331
	Total		3,419

1/ Number of tags used within the series. One tag with number 1V-187 was attached to a female with U.S.A. pup tag T-10733 and a tag with number 1V-1644 was given to a female with U.S.S.R. tag X-31893.

Table A-21. --Marked, tagged, and lost-tag seals recovered, by age, Pribilof Islands, Alaska, 25 June to 1 August 1969

Mark or tag series	Age	Marks or tags			Lost-tags[1/]			Grand total
		St. Paul	St. George	Total	St. Paul	St. George	Total	
	Years	----------Number--------			---------Number----------			Number
T	2	76	9	85	19	4	23	108
S	3	285	58	343	283	13	296	639
Hind flipper (RH3)[2/]	3	450	3	453	-	-	-	453
Hind flipper (LH2)[2/]	3	35	31	66	-	-	-	66
Front flipper (RFV)[2/]	4	375	10	385	-	-	-	385
Hind flipper (RH1)[2/]	4	388	5	393	-	-	-	393
R	4	191	5	196	159	4	163	359
Q	5	64	26	90	43	1	44	134
P	6	2	12	14	3	1	4	18
O	7	1	2	3	-	-	-	3

1/ Seals that had lost their tags but were recognized by a marked flipper.

2/ Seals not tagged but marked by removing part of a flipper--tip of third digit right hind flipper (RH3), tip of second digit left hind flipper (LH2), V-notch right front flipper on leading edge near tip (RFV' tip of first digit right hind flipper (RH1).

Table A-22. --Tag recoveries[1/] from male seals that had been selected and tagged as yearling male seals and at age 2 or older in previous years, Pribilof Islands, Alaska, 1969

Age, year tagged, and tag series	Age when: Tagged	Recovered	Total
	Years	Years	Number
Yearlings			
1965			
1R	1	5	7
1966			
1S	1	4	90
1S	2	5	2
1S	[2/] Unknown		1
1967			
1T	1	3	186
1T	2	4	20
1T	[2/] Unknown		13
1968			
1U	1	2	34
1U	2	3	36
1U	[2/] Unknown		1
Age 2 and Older			
1966			
2S	2	5	5
2S	3	6	1
2S	[2/] Unknown		1
1967			
2T	1	3	16
2T	2	4	285
2T	3	5	3
2T	[2/] Unknown		8
1968			
2U	1	2	3
2U	2	3	375
2U	3	4	29
2U	4	5	1
2U	[2/] Unknown		32

1/ In addition to the seals listed, 94 males on St. Paul Island and 15 on St. George Island that had lost two tags were taken.

2/ The tags were recovered but age could not be determined because the flippers or the heads were separated from the carcasses during the skin-stripping process.

Table A-23.--Soviet tags recovered in the United States kill of fur seals, Pribilof Islands, Alaska, 25 June to 1 August 1969

Island and date	Tag number	Age	Sex	Island of tagging	Rookery of recovery
		Years			
St. Paul Island					
31 July	X-29329, X-29330	2	M	Medny	Zapadni
30 July	X-30049	2	M	Medny	Northeast Point
28 July	X-32786	2	M	Medny	Reef
1 Aug.	X-33789	2	M	Medny	Reef
1 Aug.	X-36300	2	M	Medny	Reef
26 July	Y-35282	Unknown	M	Unknown	Zapadni
28 June	Y-17199	3	M	Bering	Polovina
16 July	Y-18968	3	M	Bering	Zapadni
25 July	Y-20670	3	M	Bering	Northeast Point
3 July	Y-20845	3	M	Bering	Tolstoi-Zapadni Reef
16 July	Y-30162	3	M	Medny	Zapadni
3 July	Y-31272	3	M	Medny	Tolstoi-Zapadni Reef
15 July	Y-31804	3	M	Medny	Northeast Point
22 July	Y-32931	3	M	Medny	Zapadni
8 July	Y-33194	3	M	Medny	Reef
22 July	Y-33422	3	M	Medny	Zapadni
31 July	Y-33667	3	M	Medny	Zapadni
9 July	T-16392	4	M	Medny	Zapadni
31 July	T-17003	4	M	Medny	Polovina
24 July	T-17318	4	M	Medny	Zapadni
9 July	T-17777	4	M	Medny	Tolstoi-Zapadni Reef
25 July	T-20089	4	M	Medny	Northeast Point
7 July	T-20572	4	M	Medny	Zapadni
17 July	T-21254	4	M	Medny	Lukanin-Kitovi
26 July	T-21653	4	M	Medny	Zapadni
14 July	T-22959	4	M	Medny	Tolstoi-Zapadni Reef
18 July	T-23083	4	M	Medny	Northeast Point
18 July	T-23852	4	M	Medny	Northeast Point
St. George Island					
1 Aug.	X-6997	2	M	Robben	North
22 July	Y-22833	3	M	Bering	Zapadni
9 July	Y-31056	3	M	Medny	East
18 July	T-16483	4	M	Medny	East
28 July	T-17252	4	M	Medny	East
28 July	T-20428	4	M	Medny	East
27 June	T-23037	4	M	Medny	Zapadni
14 July	P-24597	5	M	Medny	East
28 July	H-20244	6	M	Bering	East

APPENDIX B

Table B-1.--List of chart units occupied by a research vessel, showing hours in unit, seals seen per hour, and number of seals seen and collected [1/] off Washington, 6-28 February 1969

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
V43-H86	0.8	0	0	0
V44-H86	0.2	0	0	0
V45-H86	5.2	4.8	25	7
V46-H86	5.7	6.8	39	8
V44-H87	1.8	0.6	1	1
V45-H87	7.0	6.7	47	5
V46-H87	5.1	10.2	52	7
V45-H88	3.2	2.5	8	3
V46-H88	5.6	4.6	26	8
V47-H88	0.3	6.7	2	2
V44-H89	0.9	0	0	0
V45-H89	1.5	0.7	1	0
V46-H89	3.8	5.5	21	4
V44-H90	5.2	1.0	5	3
V45-H90	3.6	0.6	2	1
V46-H90	2.0	0.5	1	0
V47-H90	0.9	3.3	3	1
V47-H91	1.0	0	0	0
V48-H91	2.0	1.0	2	2
V47-H92	3.6	2.8	10	3
V48-H92	0.4	2.5	1	1
V47-H93	2.8	0.7	2	2
V48-H93	2.1	1.4	3	1
V48-H94	4.0	4.2	17	9
V49-H94	1.8	4.4	8	5
V49-H95	3.5	1.7	6	3
V49-H96	0.9	0	0	0
V50-H96	1.6	3.1	5	3
V51-H96	0.5	2.0	1	1
V50-H97	1.3	1.5	2	0

1/ See footnote at end of table.

Table B-1.--List of chart units occupied by a research vessel, showing hours in unit, seals seen per hour, and number of seals seen and collected[1/] off Washington, 6-28 February 1969--Continued

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
V51-H97	4.1	2.4	10	6
V48-H98	2.8	0.4	1	0
V49-H98	1.5	2.7	4	2
V50-H98	0.5	2.0	1	0
V51-H98	0.5	2.0	1	1
V52-H98	3.6	1.1	4	0
V53-H98	2.6	2.7	7	4
V54-H98	0.5	8.0	4	3
V47-H99	2.7	0	0	0
V48-H99	2.8	1.1	3	2
V49-H99	2.0	1.5	3	2
V50-H99	1.8	2.8	5	3
V51-H99	3.8	5.3	20	6
V52-H99	1.2	5.0	6	2
V53-H99	2.5	3.6	9	2
V54-H99	5.2	2.5	13	8
V52-H100	1.3	1.5	2	0
V53-H100	0.8	1.2	1	0
V54-H100	0.1	10.0	1	1

1/ The base chart is USCGS No. 5052. The sides of each unit are 10 minutes of latitude by 10 minutes of longitude. The units are located by a system of vertical column and horizontal row numbers. Vertical column numbering begins at the lower right corner of chart (fig. 11) and horizontal row numbering begins at the lower left corner.

Table B-2. --List of chart units occupied by a research vessel, showing hours in unit, seals seen per hour, and number of seals seen and collected 1/ off Washington, 1-29 March 1969

Square	Hours in unit	Seals seen per hour	Seals	
			Seen	Collected
	Number	Number	Number	Number
V43-H86	1.8	0	0	0
V44-H86	7.1	1.3	9	2
V45-H86	7.9	2.4	19	3
V46-H86	11.3	4.3	49	10
V44-H87	1.9	3.2	6	0
V45-H87	6.5	3.5	23	5
V46-H87	15.5	5.7	89	22
V47-H87	0.1	0	0	0
V45-H88	6.8	7.4	50	10
V46-H88	23.1	9.3	214	51
V47-H88	12.9	4.9	63	19
V45-H89	0.3	3.3	1	0
V46-H89	12.3	5.1	63	21
V47-H89	12.4	5.0	62	19
V48-H89	2.8	0.4	1	1
V44-H90	0.7	0	0	0
V45-H90	1.2	5.0	6	1
V46-H90	3.8	6.8	26	13
V47-H90	1.9	2.1	4	3
V48-H90	4.3	1.6	7	5
V49-H90	0.3	0	0	0
V46-H91	1.7	0.6	1	0
V47-H91	0.6	5.0	3	1
V48-H91	3.3	1.5	5	0
V46-H92	2.8	0.7	2	2
V47-H92	5.1	1.6	8	4
V48-H92	1.2	1.7	2	1
V46-H93	0.5	0	0	0
V47-H93	9.3	3.0	28	17
V48-H93	2.7	3.0	8	1
V47-H94	2.3	0.9	2	1
V48-H94	1.4	0	0	0
V49-H94	0.3	0	0	0

1/ The base chart is USCGS No. 5052. The sides of each unit are 10 minutes of latitude by 10 minutes of longitude. The units are located by a system of vertical column and horizontal row numbers. Vertical column numbering begins at the lower right corner of chart (fig. 12) and horizontal row numbering begins at the lower left corner.

Table B-3. --Number of seals seen, and number seen per boat-hunting day, by 10-day periods,[1] off Washington, 6 February to 29 March 1969

Period	Boat-hunting days[2]	Total seals seen	Seals seen per boat-hunting day	Seals seen per 10-day interval
	Number	Number	Number	Percent
6-10 Feb.	1.75	66	37.7	5.8
11-20 Feb.	6.50	250	38.5	22.0
21-28 Feb.	3.50	69	19.7	6.1
1-10 Mar.	4.75	201	42.3	17.7
11-20 Mar.	3.50	121	34.6	10.6
21-29 Mar.	6.50	429	66.0	37.8
Total	26.50	1,136	42.9	100.0

[1] The first and last periods were less than 10 days.

[2] A boat-hunting day is a day in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table B-4. --Number of seals collected, and number collected per boat-hunting day, by 10-day periods, [1] off Washington, 6 February to 29 March 1969

Period	Boat-hunting days[2]	Seals collected			Seals collected per boat-hunting day	
		Males	Females	Total		
	Number	Number	Number	Number	Number	Percent
6-10 Feb.	1.75	0	17	17	9.7	5.1
11-20 Feb.	6.50	11	57	68	10.5	20.3
21-28 Feb.	3.50	2	35	37	10.6	11.1
1-10 Mar.	4.75	3	51	54	11.4	16.2
11-20 Mar.	3.50	8	44	52	14.8	15.6
21-29 Mar.	6.50	11	95	106	16.3	31.7
Total	26.50	35	299	334	12.6	100.0

[1] The first and last periods were less than 10 days.

[2] A boat-hunting day is a day in which a vessel is used for 8 hours or more; units of boat-hunting days are 0.25, 0.50, 0.75, and 1.00.

Table B-5.--Total seals sighted, collected, wounded and lost, and killed and lost between California and the Bering Sea, 1958-69

Year	Total seals sighted[1]	Sighted seals					
		Collected		Wounded and lost		Killed and lost	
	Number	Number	Percent	Number	Percent	Number	Percent
1958	7,024	1,503	21.4	302	4.3	255	3.6
1959	5,919	1,548	26.2	316	5.3	286	4.8
1960	6,287	1,495	23.8	271	4.3	241	3.8
1961	3,415	1,352	40.0	176	5.2	124	3.6
1962	6,111	1,483	24.3	178	2.9	133	2.2
1963	5,790	1,355	23.4	202	3.5	143	2.5
1964	2,864	883	30.8	97	3.4	68	2.4
1965	1,627	419	27.8	50	3.1	45	2.8
1966	2,704	444	16.4	78	2.9	67	2.5
1967[2]	897	132	14.7	27	3.0	22	2.5
1968[3]	2,587	830	32.1	66	2.6	104	4.0
1969	1,136	334	29.4	41	3.6	42	3.7
Total	46,361	11,778	25.4	1,804	3.9	1,530	3.3

1/ Not all seals sighted are hunted.

2/ Includes 16 days during November and December 1966.

3/ Includes 25 days during November and December 1967.

Table B-6.--Total seals shot, percentage collected, wounded and lost, and killed and lost between California and the Bering Sea, 1958-69

Year	Total seals shot	Seals shot					
		Collected		Wounded and lost		Killed and lost	
	Number	Number	Percent	Number	Percent	Number	Percent
1958	2,060	1,503	73.0	302	14.6	255	12.4
1959	2,150	1,548	72.0	316	14.7	286	13.3
1960	2,007	1,495	74.5	271	13.5	241	12.0
1961	1,652	1,352	81.8	176	10.7	124	7.5
1962	1,794	1,483	82.7	178	9.9	133	7.4
1963	1,700	1,355	79.7	202	11.9	143	8.4
1964	1,048	883	84.3	97	9.3	68	6.4
1965	514	419	81.5	50	9.7	45	8.8
1966	589	444	75.4	78	13.2	67	11.4
1967[1/]	181	132	72.9	27	14.9	22	12.2
1968[2/]	1,000	830	83.0	66	6.6	104	10.4
1969	417	334	80.1	41	9.8	42	10.1
Total	15,112	11,778	77.9	1,804	11.9	1,530	10.1

1/ Includes 16 days during November and December 1966.

2/ Includes 25 days during November and December 1967.

Table B-7 .--Number of seals per group among 1,136 seals sighted off Washington, 6 February to 29 March 1969

Number of seals in group	Group	Seals	
	Number	Number	Percent
1	428	428	37.7
2	153	306	26.9
3	46	138	12.1
4	24	96	8.5
5	20	100	8.8
6	3	18	1.6
7	2	14	1.2
10	2	20	1.8
16	1	16	1.4
Total	679	1,136	100.0

Table B-8.--Thickness of subcutaneous fat in yearling[1/] fur seals collected pelagically by the United States off Washington, 1969

US-69 field number	Date collected	Sex	Measurement of fat thickness		Body		Remarks
			Sternum	Pelvic	Length	Weight	
			Mm.	Mm.	Cm.	Kg.	
	Feb.						
74	19	F	15	15	78	8.0	Examined in field, not frozen
75	19	F	15	15	76	7.0	Do.
76	19	M	15	15	75	8.0	Do.
78	20	M	15	15	70	9.5	Do.
81	20	F	14	10	76	8.0	Do.
82	20	M	4	2	77	7.0	Do.
83	20	F	15	8	75	8.0	Do.
84	20	M	17	10	76	7.5	Do.
85	20	M	10	7	80	10.0	Do.
87	20	F	7	2	78	7.0	Do.
103	25	F	7	3	82	11.5	Do.
115	25	F	15	10	75	8.0	Do.
116	25	F	12	7	79	8.0	Do.
	Mar.						
123	4	F	10	2	77	7.0	Do.
139	8	M	15	10	80	10.0	Do.
165	9	M	15	15	78	11.0	Do.
183	11	F	15	10	73	7.0	Do.
185	11	F	3	1	70	7.0	Frozen, examined in laboratory
186	11	M	7.5	7.5	76	6.0	Examined in field, not frozen
187	11	F	10	10	78	7.0	Do.
188	11	M	10	7	74	8.0	Do.
192	11	F	15	10	75	7.5	Do.
195	12	F	5	3	69	6.0	Do.
196	12	F	10	10	73	7.0	Do.
197	12	F	10	8	78	9.0	Do.
198	12	F	15	8	77	8.0	Do.
199	12	M	15	10	79	7.0	Do.
208	13	F	10	10	70	6.0	Do.
209	13	F	15	10	76	8.5	Do.
219	13	F	15	15	75	9.0	Do.
222	13	F	17.5	10	80	9.0	Do.
223	13	F	7.5	5.0	75	7.0	Do.
225	13	F	15	10	73	8.0	Do.
241	24	M	16	8	79	10.0	Frozen, examined in laboratory
249	25	F	10	5	72	8.0	Do.
250	25	M	17.5	15	76	9.0	Examined in field, not frozen
251	25	M	20	10	79	10.5	Do.
252	25	M	7.5	5	78	7.5	Do.
253	25	M	15	10	73	7.5	Do.
254	25	F	12.5	7.5	74	8.5	Do.
276	26	F	15	10	73	6.5	Do.
320	28	F	15	10	76	9.0	Do.

1/ These seals were born in late June and July 1968.

Table B-9. --Monthly mean lengths of pregnant female seals collected pelagically by the United States off Washington, 1969

Age	February		March		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
4	-	-	1	106.0	1	106.0	-
5	2	123.5	6	121.0	8	121.6	3.9
6	4	121.5	9	121.3	13	121.4	3.4
7	8	121.5	9	122.7	17	122.1	5.4
8	8	124.9	8	127.5	16	126.2	3.4
9	1	132.0	4	125.8	5	127.0	3.5
10	6	126.7	11	126.5	17	126.6	3.0
11	9	128.2	10	122.4	19	125.2	5.8
12	6	127.2	14	126.1	20	126.4	4.5
13	-	-	4	125.8	4	125.8	-
14	2	121.0	3	129.0	5	125.8	4.6
15	1	133.0	3	129.3	4	130.2	-
16	-	-	3	123.7	3	123.7	-
17	3	130.0	1	138.0	4	132.0	-
18	2	129.5	1	133.0	3	130.7	-
19	-	-	1	131.0	1	131.0	-
Total	52		88		140		

Table B-10.--Monthly mean weights of pregnant female seals collected pelagically by the United States off Washington, 1969

Age	February		March		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
4	-	-	1	22.0	1	22.0	-
5	2	29.5	6	31.2	8	30.8	2.4
6	4	32.0	1/8	32.4	12	32.3	2.7
7	8	31.9	9	34.0	17	33.0	4.5
8	8	34.7	8	36.6	16	35.6	3.0
9	1	39.0	4	36.8	5	37.2	1.4
10	6	36.5	11	37.6	17	37.2	4.4
11	9	38.2	10	38.6	19	38.4	4.4
12	6	36.9	14	36.9	20	36.9	3.2
13	-	-	4	40.0	4	40.0	-
14	2	38.0	3	42.8	5	40.9	4.1
15	1	44.0	3	40.3	4	41.2	-
16	-	-	3	38.3	3	38.3	-
17	2/2	44.5	1	45.0	3	44.7	-
18	2	39.5	1	42.0	3	40.3	-
19	-	-	1	41.0	1	41.0	-
Total	51		87		138		

1/ Nine seals collected, weight missing from one seal.

2/ Three seals collected, weight missing from one seal.

Table B-11.--Monthly mean lengths of nonpregnant female seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	February		March		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1	11	76.9	20	74.4	31	75.3	2.9
2	-	-	6	88.5	6	88.5	5.4
3	5	99.2	14	99.7	19	99.6	3.3
4	10	106.2	21	107.8	31	107.3	3.8
5	5	113.6	10	116.2	15	115.3	5.1
6	4	118.0	6	121.8	10	120.3	5.0
7	3	120.0	7	123.3	10	122.3	5.1
8	2	131.0	4	121.8	6	124.8	10.5
10	3	123.3	1	121.0	4	122.8	-
11	4	130.0	3	122.3	7	126.7	5.7
12	1	132.0	3	127.7	4	128.8	-
13	4	121.5	3	128.0	7	124.3	6.5
14	1	134.0	1	125.0	2	129.5	-
16	1	131.0	1	130.0	2	130.5	-
17	2	130.5	1	129.0	3	130.0	-
18	1	129.0	-	-	1	129.0	-
19	-	-	1	131.0	1	131.0	-
Total	57		102		159		

Table B-12. --Monthly mean weights of nonpregnant female seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	February		March		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1	11	8.2	20	7.6	31	7.8	1.2
2	-	-	6	11.2	6	11.2	2.6
3	5	17.5	14	17.2	19	17.3	2.0
4	10	21.0	21	21.7	31	21.5	2.6
5	5	24.6	10	26.2	15	25.7	2.8
6	4	31.0	6	29.2	10	29.9	4.6
7	3	32.2	7	31.7	10	31.9	3.2
8	2	34.2	4	29.4	6	31.0	4.7
10	3	32.3	1	35.0	4	33.0	-
11	4	39.1	3	32.7	7	36.4	4.7
12	1	39.0	3	36.7	4	37.2	-
13	4	35.1	3	38.0	7	36.4	6.1
14	1	46.0	1	32.5	2	39.2	-
16	1	44.0	1	44.0	2	44.0	-
17	2	41.0	1	42.5	3	41.5	-
18	1	32.0	-	-	1	32.0	-
19	-	-	1	40.0	1	40.0	-
Total	57		102		159		

Table B-13.--Monthly mean lengths of male seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	February		March		Combined length		
	Seals	Mean length	Seals	Mean length	Seals	Mean	Standard deviation
Years	Number	Cm.	Number	Cm.	Number	Cm.	Cm.
1	7	77.3	10	77.2	17	77.2	3.6
2	4	96.5	5	94.8	9	95.6	8.6
3	1	101.0	4	106.2	5	105.2	5.5
4	1	115.0	3	115.0	4	115.0	-
Total	13		22		35		

Table B-14.--Monthly mean weights of male seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	February		March		Combined weight		
	Seals	Mean weight	Seals	Mean weight	Seals	Mean	Standard deviation
Years	Number	Kg.	Number	Kg.	Number	Kg.	Kg.
1	7	8.9	10	8.6	17	8.8	1.8
2	4	15.2	5	14.7	9	14.9	3.0
3	1	19.0	4	21.8	5	21.2	3.1
4	1	32.0	3	28.0	4	29.0	-
Total	13		22		35		

Table B-15. --Monthly mean lengths and weights of fur seal fetuses collected pelagically by the United States off Washington, 6 February to 29 March 1969

Period	Male			Female		
	Fetuses	Mean length	Mean weight	Fetuses	Mean length	Mean weight
	Number	Cm.	Kg.	Number	Cm.	Kg.
6-10 Feb.	4	27.0	0.6	6	23.5	0.5
11-20 Feb.	17	27.2	0.6	15	26.0	1/ 0.5
21-28 Feb.	8	32.6	0.8	2	31.8	0.9
1-10 Mar.	16	35.9	1.2	9	33.8	1.0
11-20 Mar.	9	2/ 36.4	1.2	4	35.8	1.2
21-29 Mar.	23	40.8	1.6	27	37.7	1.4
Total	77			62		

1/ Weight missing from one fetus.

2/ Length missing from one fetus.

Table B-16. ---Reproductive condition of female seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	Nulliparous	Primiparous			Multiparous			Total
		Nonpregnant	Pregnant		Nonpregnant	Pregnant		
Years	Number	Number	Number	Percent	Number	Number	Percent	Number
				February				
1	11	-	-	-	-	-	-	11
2	-	-	-	-	-	-	-	-
3	5	-	-	-	-	-	-	5
4	10	-	-	-	-	-	-	10
5	5	-	2	100.0	-	-	-	7
6	3	1	3	75.0	-	1	100.0	8
7	-	2	-	0.0	1	8	88.9	11
8	-	1	-	0.0	1	8	88.9	10
9	-	-	-	-	-	1	100.0	1
10	1	-	-	-	2	6	75.0	9
11	-	-	-	-	4	9	69.2	13
12	-	-	-	-	1	6	85.7	7
13	-	-	-	-	4	-	0.0	4
14	-	-	-	-	1	2	66.7	3
15	-	-	-	-	-	1	100.0	1
16	-	-	-	-	1	-	0.0	1
17	-	-	-	-	2	3	60.0	5
18	-	-	-	-	1	2	66.7	3
Total	35	4	5		18	47		109
Percent				55.6			72.3	
				March				
1	20	-	-	-	-	-	-	20
2	6	-	-	-	-	-	-	6
3	14	-	-	-	-	-	-	14
4	21	-	1	100.0	-	-	-	22
5	9	1	4	80.0	-	2	100.0	16
6	5	1	7	87.5	-	2	100.0	15
7	1	4	1	20.0	2	8	80.0	16
8	-	-	-	-	4	8	66.7	12
9	-	-	-	-	-	4	100.0	4
10	-	-	1	100.0	1	10	90.9	12
11	-	-	-	-	3	10	76.9	13
12	-	-	-	-	3	14	82.4	17
13	-	-	-	-	3	4	57.1	7
14	-	-	-	-	1	3	75.0	4
15	-	-	-	-	-	3	100.0	3
16	-	-	-	-	1	3	75.0	4
17	-	-	-	-	1	1	50.0	2
18	-	-	-	-	-	1	100.0	1
19	-	-	-	-	1	1	50.0	2
Total	76	6	14		20	74		190
Percent				70.0			78.7	

Table B-17. --Pregnancy rates of female seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	February			March			Combined data	
	Seals	Pregnant		Seals	Pregnant		Feb.-Mar. Pregnant	1958-69 pelagic collections Pregnant
Years	Number	Number	Percent	Number	Number	Percent	Percent	Percent
3	5	-	0.0	14	-	0.0	0.0	0.4
4	10	-	0.0	22	1	4.5	3.1	3.4
5	7	2	28.6	16	6	37.5	34.8	38.4
6	8	4	50.0	15	9	60.0	56.5	72.4
7	11	8	72.7	16	9	56.2	63.0	79.7
8	10	8	80.0	12	8	66.7	72.7	86.2
9	1	1	100.0	4	4	100.0	100.0	89.9
10	9	6	66.7	12	11	91.7	81.0	88.9
11	13	9	69.2	13	10	76.9	73.1	88.8
12	7	6	85.7	17	14	82.4	83.3	88.1
13	4	-	0.0	7	4	57.1	36.4	86.5
14	3	2	66.7	4	3	75.0	71.4	83.2
15	1	1	100.0	3	3	100.0	100.0	82.2
16	1	-	0.0	4	3	75.0	60.0	80.0
17	5	3	60.0	2	1	50.0	57.1	68.2
18	3	2	66.7	1	1	100.0	75.0	68.9
19	-	-	-	2	1	50.0	50.0	55.3

Table B-18.--The occurrence of missed pregnancies among nonpregnant female seals collected pelagically by the United States off Washington, 6 February to 29 March 1969

Age	Females collected			
	Total	Pregnant	Nonpregnant	
			Total	Ovulated
Years	Number	Number	Number	Number
1	31	-	31	-
2	6	-	6	-
3	19	-	19	-
4	32	1	31	-
5	23	8	15	5
6	23	13	10	7
7	27	17	10	7
8	22	16	6	6
9	5	5	-	-
10	21	17	4	4
11	26	19	7	4
12	24	20	4	3
13	11	4	7	6
14	7	5	2	1
15	4	4	-	-
16	5	3	2	2
17	7	4	3	3
18	4	3	1	1
19	2	1	1	1
Total	299	140	159	50

APPENDIX C

PERSONS ENGAGED IN FUR SEAL RESEARCH IN 1969

Name	Pribilof Islands field work schedule: Start	Finish	Affiliation	Work
Permanent employees				
Alton Y. Roppel	18 June	31 July	Bureau of Commercial Fisheries	Seal research, general
Raymond E. Anas	18 June 24 Sept.	2 July 8 Oct.	..... do	Do.
Mark C. Keyes	25 June	14 Aug.	..... do	Seal research, mortality
Ford Wilke	3 July	24 July	..... do	Laboratory Director
Ancel M. Johnson	23 July	14 Aug.	..... do	Seal research, general.
Lavrenty Stepetin	When needed		St. Paul Island resident	Do.
Temporary employees				
Patrick Kozloff	16 June	2 Sept.	Student, U. of Alaska	Seal research, general.
Dionsey Bourdukofsky	16 June 24 Sept.	2 Sept. 8 Oct.	St. Paul Island resident	Do.
Agafon Krukoff, Jr.	16 June 24 Sept.	2 Sept. 8 Oct.	..... do	Do.
Jerry S. Stearns	18 June	2 Sept.	Student, Oregon State U.	Do.
Peter A. Dzikiewicz	18 June	27 Aug.	Cornell U. (leave of absence)	Do. and tourist guide
Ronald G. Pletnikoff	18 June	2 Sept.	St. Paul Island resident	Seal research, general.
Perfenia Pletnikoff, Jr.	25 June	2 Sept.	..... do	Do.
Thomas A. Gornall	25 June	21 Aug.	Student, Wash. State U.	Seal research, mortality
	Pelagic Investigations			
Permanent employees				
Clifford H. Fiscus	6 Feb.	31 Mar.	Bureau of Commercial Fisheries	Seal research, general.
Hiroshi Kajimura	6 Feb.	31 Mar.	..... do	Do.
Merrill A. Petterson	6 Feb.	31 Mar.	..... do	Do.
Temporary employees				
Stephen D. Treacy	None		Bureau of Commercial Fisheries	Seal research, general.
Robert G. Forbes	6 Feb.	31 Mar.	..... do	Do.
Arthur A. Harvey	6 Feb.	31 Mar.	..... do	Do.

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